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The proposed Philadelphia and New York ship canal, if built, will run from Bordentown, on the Delaware River, to the Raritan River, east of New Brunswick, N. J., a total distance of 33.74 miles. The greatest elevation is 76 ft. above tide, and a considerable portion of the route follows the 50 ft. contour, which is proposed for the summit level, with two locks at either end, of 25 ft. lift each, and two tide locks, making six locks in all. The locks are to be 500 × 60 ft. The cross section used in the estimates is 90 ft. wide at the bottom and 20 ft. deep. This gives the excavation at 26,327,614 cu. yards., with 350,000 cu. yds. of dredging at the approaches. The area of the watershed tributary to the summit level is over 300 sq. miles. This would require to be utilized by one or more feeders and reservoirs, but there is an ample water supply for a traffic of at least 30,000,000 tons. The estimated cost of the entire work, exclusive of right of way, is $12,552,900. Prof. L. M. Haupt, late of the University of Pennsylvania, is one of its chief promoters.

The roads of Staten Island (Richmond Co.), New York, are being improved on modern methods. The act for this work was passed in June, 1890, and provides for the continuous maintenance as county roads of all such town and public roads as may be designated by the Board of County Supervisors, and that the practical work of both construction and repairing must be in full control of a competent engineer. There were 67 miles of road, sufficient to thoroughly gridiron the island, included in the preparatory surveys and contracts were made for 30 miles to be constructed at once. The design was to construct roads of the best telford and macadam pavement, and to bring such existing roads as might be repaired to the same standard. Of the work included in the first contracts, 6 1-3 miles were telford pavement, 16 2-3 miles new macadam, and 7 miles repairs. The width of the roads varies from 14 to 30 ft., according to locality, and the depth of the roadbed from 6 to 12 ins. The cost is estimated at an average of $8,500 per mile. It will amount to about $250,000 for the work under way, and a similar amount for that projected. Of the 30 miles of road covered by the present contracts, 18 miles were completed before the severe weather of last winter, and the rest will be completed this summer. The amount expended up to date is $158,688. There are about 250 men employed, although as many as 600 have been employed. There are seven steam rollers, one of 20 tons weight, one of 15 tons, and the rest of 10 tons. Mr. Wm. S. Bacot, M. Am. Soc. C. E., of Stapleton, N. Y., is Engineer of County Roads, and the specifications for the work were given in our issue of Dec. 13, 1890.

The iron ore resources of Ontario, Canada, seem likely to be developed, and it is reported that capitalists have in hand a project for the erection of blast furnaces near Toronto, and are urging the Provincial Government to grant financial aid. It is proposed to erect furnaces with a capacity of smelting 100 to 150 tons of pig iron daily. The ore is said to be of superior quality, and low in phosphorus. It is proposed to use coke for fuel. The Government is asked to pay a bonus of $2 per ton for all ore mined, and it is thought that, as this will help develop the iron-mining industry of the country, the request will be granted.

The railway traffic of Chicago has been given as follows, the figures being the number of trains per day:

Through express and mail trains	262
Accommodation and suburban trains	660
Freight trains	274
Grain, stock and lumber trains	164
Total regular trains	1,360
Number of companies operating	28
Number of lines operated	40

The Chicago Drainage Board has accepted the report of its committee on engineering and finance upon the proposals received for the canal construction from Willow Springs to Joliet, recommending that contracts be awarded to the lowest bidders under Proposition No. 2. This work is in 14 contracts, upon which the lowest bids are distributed between six firms, and the aggregate of these bids is $10,696,755. The project was described and illustrated in our issue of June 2, and the bids were given in our issue of June 16. In a later issue we shall give an abstract of the committee's report, and a list of the quantities and prices of the lowest bids.

One of the most powerful compound locomotives in existence is a heavy consolidation engine on the Vauclain four-cylinder compound system (Eng. News, Feb. 26), built for the Cornwall & Lebanon R. R., of Pennsylvania, by the Baldwin Locomotive Works, Philadelphia. The leading dimensions and particulars are as follows:

Cylinders, h.p.	14 × 24 ins.
" l. p.	28 × 24 "
No. and diam. of driving wheels, S.	4 ft. 2 "
" " truck wheels, 2	2 " 6 "
Boiler	11-16-in. steel; straight top
" diameter of barrel	6 ft. 0 ins.
Working boiler pressure	180 lbs.
Firebox	10 ft. 1 3-16 ins. × 3 ft. 6 ins.
Tubes (iron), number	271
" diam. 2¼; thickness	No. 13 W. G.
" length	13 ft. 6 ins.
Wheel-base, driving	14 " 0 "
" total	22 " 3 "
Weight on driving wheels	135,000 lbs.
" on truck wheels	15,000 "
" total	150,000 "
Capacity of tender tank	3,600 gallons

Brake fittings, Westinghouse-American for driving and tender wheels.

A two-cylinder compound locomotive, built, by the Cooke Locomotive Works, Paterson, N. J., is being tested on the New York, Lake Erie & Western R. R.

The Hyde Park water-works crib (Chicago) was launched at the foot of Michigan St. on June 16. It is 75 ft. in diameter, and weighs 25 tons. It will be moored in the river while the superstructure is being built and will be towed into its final position about July 1. It will be stationed 6,500 ft. from shore of 68th St. Messrs. Shailer & Schniglau, Chicago, are the contractors.

As indicating the feeling on the question of better roads in Illinois, we print below an abstract of resolutions passed at a meeting of representative farmers of Stephenson Co., held at Freeport, Ill., on June 9:

Resolved, That the Senator and Representatives to the General Assembly from this Senatorial district be requested to use their best efforts to secure the passage of a law making permanent roads a county matter, and to authorize the issuing of county bonds for that purpose; and that a committee of three be appointed by this convention to correspond with the proper authorities of the different counties in the State and urge upon them the advisability of instructing their representatives for the passage of such a law. And be it further

Resolved, That in the sense of this convention the Board of Supervisors of this county should make a levy of 20 cts. per $100 on all taxable property of this county, said levy to be appropriated for building permanent roads under the directions of a committee of said board and the Commissioner of Highways in the town in which the improvement is made.

An interesting exhibit is being prepared by the Baltimore & Ohio R. R. for the World's Columbian Exposition. It will include models of the first track, cars and locomotive built by this company. The track was 14 miles long, and extended from Baltimore to Ellicott Mills, Md. The rails were iron straps nailed to wooden stringers. It was opened May 24, 1827. The cars were open coaches, appropriately called wagons, and were drawn by horses. The first locomotive, called the "York," was built by Phineas Davis, at a cost of $4,000.

Only 100 ft. of the four mile water-works tunnel at Chicago remains to be driven, and it is expected that this will be completed about June 25. It will be put into use about Sept. 1.

The most serious railway accident of the week was the derailment of a passenger train at a washout near Hillhurst, Que., on the Grand Trunk Ry., June 20, by which four men were killed and four injured. The engine, mail, express, baggage and one passenger car went down. A serious rear collision occurred June 15 on the Philadelphia & Reading R. R. at Fort Washington, Pa. A switch engine had been running ahead of a fast express, and was attempting to switch onto the other track when it was overtaken by the express. Both engines were wrecked and the smoking car overturned. One man was killed and ten were injured, some seriously. The accident was due to the running of a light engine so close in front of an express train.

A bridge accident caused by a derailed car striking the supports of an overhead bridge occurred June 13 on the Pennsylvania R. R., at the Girard Ave. bridge, West Philadelphia. About 4:30 a. m. a car loaded with stock, eastbound, was derailed west of the bridge by a piece of iron, which had fallen from some car onto the track. When the derailed truck reached a point just west of the bridge, it struck a frog, which slewed the truck around, causing it to strike against the cast iron columns supporting the bridge, breaking them off and letting a portion of the bridge fall on the tracks and train. Enough of the bridge remained, however, uninjured to allow city traffic to pass along Belmont and Girard Aves., as the part destroyed was in the northwest angle, formed by the intersection of the two avenues. A large force of men removed the debris as speedily as possible, and by 8 p. m. all tracks were cleared. Six of the nine tracks were blocked by the wreck, leaving two passenger tracks and the cutting track next to the westbound passenger track open. For the facts of the case, we are indebted to Mr. Thos. Gucker, Superintendent of the Philadelphia Division.—A trestle on the Knoxville, Cumberland Gap & Louisville R. R., about nine miles south of Cumberland Gap, Ky., gave way under a double header freight train June 14. The trestle is said to have been 135 ft. high. Two men were killed and four injured.

Two bridges are reported burned. The Northern Pacific R. R. bridge, of five 100 ft. spans, at Clark's Fork, Idaho, was partially burned June 18. The middle span of the Stone River bridge on the Lebanon branch of the Nashville, Chattanooga & St. Louis Ry. was burned June 17. The eastern span was burned three years ago, and was replaced with iron; the middle and western spans were combination trusses.—A collision in the 12th St. freight yard at St. Louis resulted in knocking down two of the columns of the bridge, carrying 12th St. over the tracks, and about 100 ft. of the bridge fell. The accident was similar to the one at Philadelphia, noted above.

An appalling false works disaster, by far the worst of the kind on record, happened at 10:25 a. m., Wednesday, June 15, to a new highway bridge across the Licking River, between Newport and Covington, Ky., too late to have a proper record of it appear in our last week's issue. The facts in regard to the disaster are more fully given on another page of this issue.

Dam No. 2 of the Mahanoy City Water Co., Mahanoy City, Pa., gave way on the night of June 17. The dam was about two miles from the city. The streets were flooded and much damage caused, but the people were warned in time and only one man was lost. The reservoir had a capacity of 3,000,000 gallons, and the dam had been under repair. The Lehigh Valley R. R. embankment checked the flood for 20 minutes until the water flowed over the bank and caused a breach, and this time enabled many persons to escape. The dam of the reservoir of the Pottsville Water Co., southwest of Frackville, Pa., is reported to be lacking and in an unsafe condition, and residents in the valley have been warned of the danger.

Another tubular or submerged tunnel plan is proposed, according to an English paper, and a patent has been taken out for a scheme which, it is claimed, will solve the Channel tunnel difficulty. The inventor is Mr. Joseph Holden, a Lancashire journalist and shipping agent residing at Accrington. His patent is for connecting countries and places divided by rivers or seas over sea railways and submerged tunnel railways. Both systems will be supported on pontoons which will be raised to any required altitude or sunk to any required depth, and securely fixed on all sides by iron or steel cables so as to present a perfectly firm and immovable foundation. In crossing the Channel a circular tunnel of iron or steel would be constructed which would be sunk to a depth where it would have most support on the elevations of the bottom; the intervening supports being pontoons.

A GREAT SWITCH AND SIGNAL PLANT.

From information furnished us by an English correspondent, and from the particulars published in our English contemporaries, we have prepared the following article on the extensive alterations and extensions that have recently been completed in connection with the track arrangements and signal plant at the Waterloo terminal station of the London & Southwestern Ry., in London, which is one of the busiest of the London terminals. It is claimed that the new signal box and the signaling scheme or system in general are the largest in the world, but, on the other hand, it has been said that the London, Brighton & South Coast Ry. signal box at the London Bridge terminal, which contains 280 levers, and the London & Northwestern Ry. signal box, at the Euston terminal station (London), which contains 283 levers, are larger than the Waterloo station system. It is true that the Waterloo signal box only contains 236 levers, 16 of which are gear levers and locking levers, and are simply put in for the assistance of the interlocking, but the Waterloo plant has been carefully and specially designed to be operated by as few levers as possible, and it is further claimed that if this plant had been arranged with the same liberality in the use of levers as that at any others of the large stations, between 400 and 500 levers would have been required.

Previous to the year 1878 there were ten passenger tracks, being those from (3) to (12) in the general plan Fig. 1, which represents the arrangement as finally completed in May, 1892. In 1878 the two platforms (1) and (2) were added, and in 1885 five additional tracks were added at the north side of the station, as well as all the side tracks for Windsor trains at the north side of the station. The platform and passenger track accommodation has been practically doubled since 1878. For some years past work has been in progress on the widening of the four-track masonry viaduct over which the railway runs to the Waterloo station, and this has recently been completed, giving six approach tracks. The telegraph wires along the viaduct became so numerous that they have been all placed in underground conduits as far as Clapham Junction, and it has therefore been possible to place the semaphore arms or blades much lower than would otherwise have been the case. The viaduct work and new tracks have been constructed under the supervision of Mr. E. Andrews, Chief Engineer, and Mr. A. W. Szlumper, Resident Engineer. On April 9, the day of the Oxford and Cambridge boat race and the Sandown Park horse races, there were 819 incoming and outgoing trains, or an average of 45 per hour. To control this number of trains according to the ordinary method in use involves 18,000 lever movements and the sending of 20,000 electrical signals. During a few hours in the busy time in the morning the number of switching operations was 173, while from 4 p. m. to 6:40 p. m. the number was 131. In 1874 the number of levers in the old "A" signal box was 109, and the average number of movements was ten per train, including switching, there being then no facing switch locks in use. With this additional safeguard provided, the average number of movements required is now 22 per train, and the number of levers in the old "A" signal box, previous to the new arrangement recently completed, had increased to 209, giving an aggregate of nearly 5,250,000 lever movements during the year. The following table gives the details of traffic entering and leaving the station by the four tracks on July 19, 1891, between 7 a. m. and midnight:

	Main tracks.		Windsor tracks.		
	Inb'd.	Outb'd.	Inb'd.	Out'bd.	Total.
Trains.	123	111	126	135	495
Engines	47	31	15	31	124
Empties. . . .	40	26	25	59	150
Specials	33	27	11	8	79
Total	252	195	177	233	857

In regard to the arrangement of the plant, it is said that at London Bridge, Euston, Cannon St., or any other of the large London terminals which are provided with large signal boxes, every movement—that is to say, every signal—is worked by a separate lever, and one signal is often worked by more than one lever. Special levers are provided in order that the locking may be reduced, and we are informed that generally levers are recklessly provided so that special locking shall not be necessary in the interlocking apparatus. When the new Waterloo arrangement was originally devised, Mr. J. P. O'Donnel, M. I. M. E., who was one of the signal experts consulted, and by whom the entire system was originally planned and designed, concluded that where a series of tracks lead onto one track, or where more than one movement takes place from one track to another, it was a waste of levers and mechanism to provide separate levers for each movement, provided that not more than one of such movements shall take place at once. Take for instance an inbound train on the "up Windsor" line, in Fig. 1. A signal is provided to give authority to run to, say, platform track (14); a separate signal for switching from the "up Windsor" track to platform (14) and a third signal for switching out from the platform onto the incoming track or "wrong road." It is evident that out of these three distinct movements only one at a time can be given with safety, and that it is no inconvenience to traffic to arrange one lever to work the three signals, each signal being given separately as desired, according to whether it is a passenger movement, a switching in or a switching out movement. The explanation with reference to the "up Windsor" track and platform (14) applies throughout the scheme, from the "up Windsor" track to all the platform tracks that can be entered from that track, which include down to platform track (7). The same takes place from the "down Windsor through track." There are out passenger signals for that track, switching-out signals onto it, and switching-in signals from it to any platform which can be entered from the same and the roads to it. The same traffic facilities by signal are provided for the "down Windsor local," "up main through," "up main local," and "down main" tracks. The curved dotted lines across the platform tracks, on the right of Fig. 1, indicate the several tracks which can be entered from each of the six approach tracks.

To provide the full usual number of levers for the signals only in connection with the six main tracks approaching Waterloo and the signals out in connection therewith, it is said that it would have taken

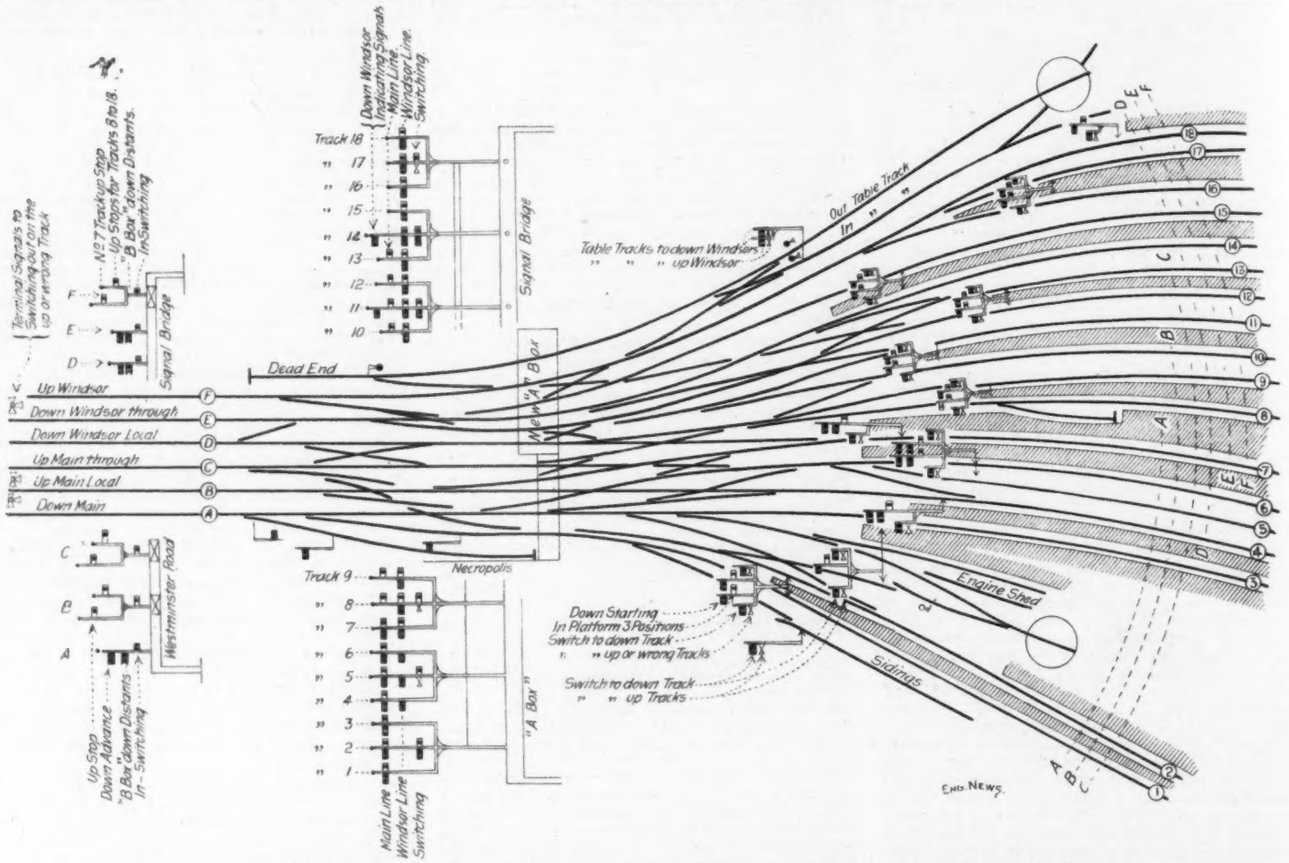


FIG. 1. PLAN OF TRACK AND SIGNAL ARRANGEMENT AT THE WATERLOO (LONDON) TERMINAL STATION, LONDON & SOUTHWESTERN RAILWAY.

about 230 levers, and that at any of the other large stations such a number of levers would have been provided for the large number of signals which are necessitated at the station. At Waterloo, however, to work the signals named there are provided only 74 actuating levers and six gear levers. This has been effected by the adoption of the No. 4 "Simplex" machine for interlocking gear. This machine is the invention of Mr. J. P. O'Donnell, M. I. M. E., 2 Great George St., London, and is already extensively used on several railways. By its adoption the railway company was enabled to save the difference between 80 levers and 230 levers, or about 150 levers saved in the locking frame. As already noted, it is said that if Waterloo had been signaled with the same complication that others of the large stations are signaled there would be required to be in the "A" box between 400 and 500 levers instead of 236 now provided. Practically every switch in the yard is a facing switch, and provision is made for the use of all platforms as both arrival and departure platforms, while the interlocking has been so arranged that where a train can get into a platform track by more than one way, such other ways are properly interlocked and provided for, and safety is given by signal and not by flag. Hand signaling has been practically abolished. The number of levers is as follows:

Signal levers, working 247 connections	102
Switch levers, working 81 switches	50
Facing switch-lock levers, working 68 switches	46
Gear levers, working to three positions	7
Setting levers for alternative routes	16
Space levers	15
Total number of levers	236

The locking frame was supplied by Stevens & Sons, of Southwark, and the work has been carried out by the London & Southwestern Ry. Co., under the superintendence of the company's engineers. Considering the magnitude of the scheme great credit is due to all concerned for the manner in which the work has been carried out without the slightest accident, especially as for some days there was not the full protection in the nature of switch locks and other safety appliances. When the system had been completed as far as practicable the company took down the stanchions supporting the girders of the old signal box, in order that the remaining frogs, switches and signal plant might be put into position. The scheme is elaborately provided with electrical appliances, and the "lock and block" system has been added between the signal boxes. These appliances, together with many special arrangements required for this particular place, were designed and carried out by Mr. W. R. Sykes, the original inventor of the "lock and block" system.

The following details are taken from an article in the "Railway News":

As will be seen by the plan the new "A" box spans only a portion of the lines entering the station. Owing to the exigencies of situation the line approaches the terminus with reversed curves, and the northern portion of the station is laid out on a curve. The situation chosen for the new box nearly covers the site of the old structure, and is chosen as giving the best views into the various platforms and down the line. Provision has been made in the box for a separate signal for all passenger and shunting operations throughout the whole of the station.

The locking apparatus consists of two parallel rows of levers which interlock under the floor in wide locking troughs in which horizontal tappets work at right angles to the sides and locks on the well known tappet principle, and so far as the actual interlocking achieved it is by far the largest apparatus in existence (though not as regards the number of handles), the 236 levers being interlocked for and doing the work of over 350 levers, the connections of some 70 levers being put in and out of gear by seven gear levers, so that they work three distinct sets of connections and different signals conditional on the position of the gear levers; different interlocking taking place to suit the different signals worked by the one lever.

It has hitherto mostly been the custom to erect lofty semaphores for signaling purposes, with long rows of signal arms relating to the various lines. The difficulty of a driver in distinguishing his proper signal must be great under such circumstances, and it has been sought in the "A" box to range the arms over their respective lines. One of the station signals comprises 67 arms and another 21, while there are twelve bracket signals at the ends of the platforms. Mr. W. R. Sykes, the electrical engineer who has had the contract for this portion of the work, has introduced his system of electric interlocking and block system between box and box, making conflicting movements between the locking apparatus and block-signaling instruments impossible. On the rails by the side of each platform a treadle bar is arranged, which is pressed down by the train while at rest, which, in doing so, gives indication of its presence to the signal box. On the train leaving the platform on its outward journey the treadle flies up and unlocks the levers, to enable another train to enter that platform bay. The advance treadle sets an electric bell ringing in the box, only to be stopped by the moving of the appropriate signal lever, which, being set, protects its rear—a novelty which adds considerably to the safety of the traffic. Occasionally a train or engine has to switch on to the wrong road, and this exceptional movement is signaled by means of a "scissors" arm by day, and a purple light—instead of a green one—at night. A short distance along the line, where such eccentric movements would be a danger to the traffic, an automatic signal is constructed, which places three fog signals in succession on the line, a bombardment which would suffice to recall the driver to a sense of his position.

About 100 yds. from the "A" box down the line a specially constructed signal bridge spans the six tracks, of which the railway from this point consists. These signals cover the incoming stop, and switching, and the outgoing advance signals. From this point the signaling is taken up by the "B" box some 200 yds. further down the line, where the station department may be said to end. At the "B" box the whole or any portion of the traffic can be entirely diverted by a system of cross-over lines with angle or "slip" crossings and points from the main to the Windsor line, and vice versa. A signal bridge on the station side worked from this box controls the outgoing traffic, and a similar bridge on the Vauxhall side carries the incoming signals.

Special cross-shaped signals have been fitted to the signal bridge at Westminster Road Bridge to protect trains and engines when switching out of the station yard on the respective incoming tracks. These are worked simultaneously with the "wrong track" signals on the standard posts. When at "danger" these special signals show a red light, which must not be passed by incoming trains, as it indicates that a train is switching out on the incoming track. When at "caution" they show a purple light to the incoming train. The "wrong track" or "switching out" signals show a purple light for "track clear" for the train which is switching out on the incoming track. The cross-shaped disk ground signals near the signal bridge must not be passed when at "danger" under any circumstances. Fig. 2 shows the arrangement of signals at the "A" box as seen from incoming or "up" trains; the arrangement as seen from outgoing or "down" trains being shown on a smaller scale in Fig. 1. Only the arrival signals governing the platform tracks are provided with white lights. Any other signal showing a white light must be considered a danger signal, as it will indicate that the signal has failed or the glass been broken. Signals are placed at the west end of the platforms; at "track clear" they indicate that the entire platform track is clear; at "caution" that cars or a part of a train are on the track, and an incoming train must enter slowly; and at "danger" no train must pass, but light engines may back down past them to be coupled to their respective trains. Incoming light engines must call the attention of the signal men at "A" box by whistling.

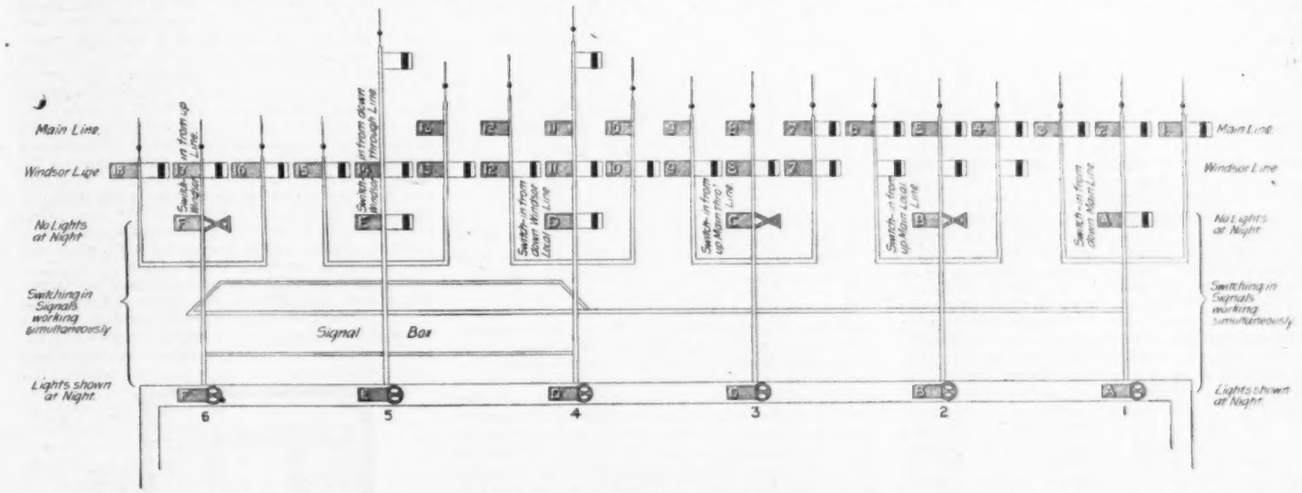


FIG. 2. VIEW OF SIGNALS ON MAIN SIGNAL BRIDGE, AS SEEN FROM INCOMING TRAINS; WATERLOO (LONDON) TERMINAL STATION, LONDON & SOUTHWESTERN RAILWAY.

UTILIZATION OF WATER-POWER OF THE FALLS OF THE VALOIRETTE.

The torrent of the Valoirette, a tributary of the Arc River, in the vicinity of the Mont Cenis, is being utilized for industrial purposes. From the "Zeitschrift des Vereines Deutscher Ingenieure" we abstract the following:

From near the point of junction of the Valoirette and the Arc, a canal 2,625 ft. in length, 6.5 ft. wide by 3.7 ft. deep, having 0.22% fall, and permitting the passage of 106 cu. ft. of water per second, has been constructed to the reservoir. This is 440 ft. above the Calypso plains, where several factories are to be erected. The canal had to be tunneled for a distance of 387 ft. through a very hard kind of limestone. It was completed in less than six months, and 26,160 cu. yds. of rock were removed by blasting. At present one factory, manufacturing aluminum and its alloys, has been connected with the reservoir by a 24-in. pipe-line, deriving 1,000 HP. therefrom. One turbine which is coupled directly with a dynamo, making 135 revolutions per minute, generates 4,000 amperes at 500 volts tension. The entire hydraulic plant is capable of supplying 6,000 HP.

THE DESIGN OF LOCOMOTIVE SMOKE-STACKS AND EXHAUST NOZZLES.*

There is a wide difference of opinion on this subject, even after the careful investigation and experiments conducted in the past by zealous and thoughtful mechanics. Experiments made with the greatest care and with the most approved appliances produced at times very conflicting results, due to the variable character of work performed by the engine with heavy and light trains, low temperatures, head winds, etc. The character of coal changes greatly, even when from the same mine; this may be due to moisture or an unusual amount of impurities. Among other matters which affect engine tests might be mentioned the inequalities in the transmission and absorption of heat due to the presence of foul water, various amounts of deposits of sediment and incrustation in the boiler, and, above all other causes, careless firing.

It is quite natural for the fireman to govern the quantity of coal thrown into the furnace by the variation in steam pressure, and he is not always sufficiently careful to observe whether the box already contains more coal than is required for perfect combustion.

Aside from the wasteful feature in this case, the effect is to entirely change the condition of the draft by raising the vacuum in the smokebox. While an engine with a light fire and free admission of air through the grate bars would ordinarily develop a vacuum of 3 or 4 ins.; it will, with a fire that is sufficiently heavy to obstruct this free admission of air, under conditions of draft otherwise the same, produce a vacuum of 15 ins. or even higher, the effect of which is to lift the fire from the grate bars where it is lightest, leaving the heavier portions of the fire unsupplied with sufficient oxygen to produce perfect combustion. This increased draft upon the fire draws a great quantity of partially consumed coal through the flues. Now, while it is not possible in all cases to regulate and correct this bad judgment of the fireman, it has often occurred to me that this increased vacuum could be utilized to automatically control a mechanical attachment to an expansion nozzle, or Luttgen's smokestack damper, both of which devices have merit, if used properly.

To further illustrate the difficulty in establishing a uniform standard of sizes and arrangement of smokestack and exhaust pipes, I wish to call your attention to the variation in the volume and action of the steam in its passage through the cylinders and exhaust pipes, and will take for illustration an engine with 18 x 24-in. cylinders and 6-ft. driving wheels. This engine when working at 10 ins. cut off (a point where it would probably develop its greatest power and speed) would pass through its cylinders at each revolution 10,178.4 cu. ins. of steam. Let us imagine that this engine has attained a speed of 60 miles per hour, or 280 revs. per minute, and we have a volume of 2,849,952 cu. ins. of steam each minute. Assuming that this steam is conducted from the boiler to the cylinders and the exhaust through steam pipes and connections having an average sectional area of 28,274 sq. ins. (or 6 ins. in diameter), the steam has a flow of 8,960 lin. ft. per minute. Assume this 60 miles per hour as a maximum of speed (although claim has been made that a speed of one mile in 39¾ seconds has been attained, or 91 miles per hour), and by comparing the same to the minimum of the exhaust, you will recognize how hopeless is the task of designing a standard exhaust pipe and stack that will produce an equally good effect for the wide range of conditions required. While the evolution of other parts of the locomotive has been very marked, the draft appliance is substantially the same as it was on the first engine. It works on the old-time principle of full stroke or nothing.

If you will read the report of the committee, and the discussion that followed, at the last Master Mechanics' convention, you will realize that there is a very marked difference of opinion and practice among our most progressive mechanics. While one advocates a smooth and gradual taper from the base to the tips, another was of the opinion that it would be better if the exhaust pipe were turned bottom side up; while one cautioned his fellows against irregular surfaces or contractions or enlargements in the area of the passage, another thought a chamber or reservoir in the pipe would prove beneficial (see Eng. News, June 20, 1891.)

In regard to smokestacks, I take the liberty to quote the following:

> The committee has had considerable experience with both straight and taper stacks, and is of the opinion that the stack with double taper is decidedly the best, and that the size of the stack has a very marked effect upon the steaming with any given nozzle. Reduction in stack diameter will generally permit of increase in nozzle diameters.

The reduction of the stack near its base with a double taper depends on a recognized scientific fact, that a jet of fluid issuing from an opening has a form known as the "contracted vein." Trautwine says that while all fluids, water, mercury, air, etc., whatever may be their specific gravity will flow with equal velocities from opening of equal sizes under equal heads, it has been found that with a nozzle or tube constructed on certain lines (see fig. 10, p. 260 of 1887 edition, Trautwine's Pocket Book), the discharge may be increased 50% beyond its theoretical opening. It is evident that the effect of making the locomotive stack conform to the contracted vein is to reduce the friction of the gases, increase the velocity of their discharge, and offer less resistance to the action of the exhaust, thereby increasing the vacuum and reducing the back pressure in the cylinders.

It is, of course, impossible to construct a stack strictly on these lines; and from my own experience in constructing stacks of 18 ins. extreme diameter down to 13 ins., I have found that we get the best results with a stack contracted to 15 ins. at a point 12 ins. above the saddle and tapering to 18 ins. at the top, with a total length of stack of 63 ins. If contracted below 15 ins. the engine will make steam very slowly under natural draft and when first fired up. While the length above is not arbitrary I have found that with 54 ins. or less in length the results are not so good.

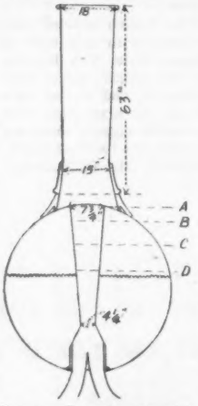


Fig. 1. Experiments with Exhaust Nozzles of Various Lengths.

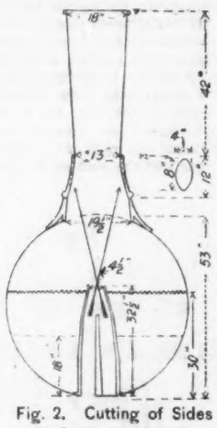


Fig. 2. Cutting of Sides of Stack by Jet from Single Exhaust Nozzle.

While considering this principle in a stack it occurred to me that the same form might be used in the exhaust pipe carrying out the full lines as laid down in Trautwine, as shown in Fig. 1, the top of the pipe being on a line with the base of the stack; this, however, defeated all that we had gained by improving the shape of the stack, for it prevented a proper combination of the gases with the exhaust at the line of contraction. I reduced the height gradually as shown by lines A, B, C and D, until at the present time the top is about 3 ins. above the center line of boilers, and while I have not yet succeeded in establishing the correct relation between the top of the pipe and the stack, I still think the principle is correct, and its use will result in a decrease of back pressure in the cylinder, as well as a milder draft that will lead to fuel economy. The developments in connection with the compound locomotive have demonstrated that steam can be maintained with a much milder draft than is usually employed in the simple engine, and a large share of the fuel economy of the compound (particularly in the four-cylinder type) is due, I believe, to this cause.

I wish to say a few words about the height of the bridges in the ordinary form of single exhaust pipes. It is my opinion that the hump that appears above the atmospheric line in the indicator diagrams from many engines with single nozzles, is not due to the exhaust blowing over, but to the ordinary increase of resistance to the out-flowing steam. In my experiments I have found that the column of steam in the exhaust pipe is not instantly compressed or altered in direction at the nozzle sufficiently to insure a central discharge into the stack, but is deflected from side to side at the relative angles at which it approaches the discharge. In my experiments with an exhaust pipe, as shown in Fig. 2, in which the bridge approaches within 8 ins. of the nozzle, the effect was to send the steam from side to side, and in three months I found that each side of the stack base was cut out to a depth of ¼ in., in an elliptical form, which was 8 ins. in length and 4 ins. in width. You will note that the column of steam remains at the same general angle at which it approached the exhaust tip. This points to the necessity of a low bridge that will allow the column to straighten before it reaches the nozzle. The momentum of the exhaust will insure its upward tendency with a very slight bridge at the base of the exhaust pipe.

* A paper by W. H. Lewis, Master Mechanic, Chicago, Burlington & Northern R. R., read at the May meeting of the Western Railway Club.

THE MANUFACTURE OF VITRIFIED SEWER PIPE.*

The process herein described is that used by the well known firm of Evens & Howard, St. Louis, Mo., to whom the writer is indebted for information kindly furnished. Their mine and factories are located at Howard Station, on the Missouri Pacific, and St. Louis & San Francisco railways. The sizes manufactured by them vary from 3 to 24 ins. in diameter, and the capacity of their works is 100 tons of pipe per day, which is equivalent to a mile of 10-in. pipe, ½ mile of 15-in. pipe, or 1-5 mile of 24-in. pipe.

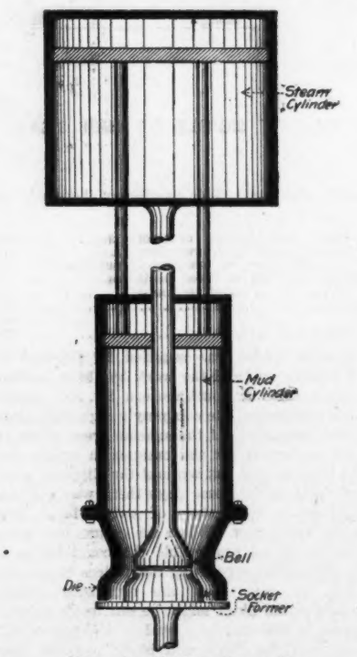
The ingredients of the clay from which the pipe is made are as follows:

		SiO_2	43.93
		Al_2O_3 } Ti_2O_3 }	40.09
Fire clay	40%	H_2O	14.30
		Free Silicon	0.60
		K_2O	0.20
		Fe_2O_3	0.88
			100.00
Surface soil	40%		
Yellow clay	15%	"grog."	
Burned pipe	5%		
	100		

The fire clay is mined near the works, from a vein 8 to 10 ft. thick and 60 ft. below the surface. It is of a grayish color, its specific gravity is 1.75, and its hardness is ½ to ¾, taking talc as 1 and diamond as 10. It is mined in the same manner as coal. That for pipe is molded at once, while that intended for brick, tile, and retorts is weathered by dumping in a pile and allowing rain, frost, etc., to pulverize it. The surface soil is the ordinary dark soil on the surface, and is taken as it is needed. The loamy clay is used to reduce the cost of material and to reduce the temperature required for vitrification.

The clay is prepared for molding by being passed through the "dry mill" and then through the "wet mill." The dry mill consists of a horizontal rotary disk, or pan, in which roll two heavy wheels. The disk is of cast iron and is 9 ft. in diameter; that portion upon which the wheels grind is solid, while the portion from the wheels outward is perforated, so as to allow the finely ground material to drop through. The disk is fixed to a vertical shaft, carrying at its upper end a miter wheel, which gears with a similar wheel on the main shaft. The wheels are of cast iron, with hard cast iron tires which can be replaced when worn out, are 4 ft. in diameter, and weigh 6,000 lbs. each. They are mounted on a horizontal axle, which is free to slide between vertical guides, are placed 4 ft. apart and rotate by contact with the horizontal disk.

Into this dry mill the fire clay and grog are thrown and ground. The material on leaving the wheels is thrown outward by the rotation of the disk, the fine material falls through the holes in the disk and the coarser particles are again brought under the wheels



Press for Molding Sewer Pipe.

by two scrapers at opposite parts of the pan. The finely ground material is carried over a set of screens; that which passes the screens goes to the bin, while the coarser particles again return to the dry mill.

The wet mill differs from the dry mill in that in the former the disk is not perforated and the wheels weigh 3,500 lbs. each instead of 6,000 lbs. Otherwise the two are alike.

From the bin the dust is allowed to run into the wet mill, where it is mixed with water and re-ground until

* A paper by Wm. C. Klingelhoeffer, School of Civil Engineering, University of Illinois, published in "The Technograph."

it forms a paste. Then the surface soil is added, and the whole wetted and ground until it forms a stiff mud, when it is delivered, by means of a scoop, into the elevator which conveys it to the press.

The press consists of a steam cylinder and piston, a mud cylinder and piston, the bell, the die, and the bell or socket former. The steam piston is 40 ins. in diameter and is connected to the 20-in. mud piston by means of three rods. When the steam pressure is 90 lbs. per sq. in. the pressure exerted by the mud piston is 360 lbs. per sq. in.

The mud cylinder is vertically underneath the steam cylinder, and has attached to its lower end the die. This die is of cast iron. Its lower end shapes the outside of the bell, or socket, of the pipe. Above the socket former the die is a right cylinder for two or three inches. This part shapes the body, or straight portion, of the pipe. Above this the die is divergent or convergent, as the pipe is smaller or larger than the mud cylinder. The bell also is of cast iron, two or three inches of its lower end being a cylinder of a diameter equal to the inside diameter of pipe. Above this part the bell is made tapering to connect it with a heavy rod which passes through the mud piston and is fastened to the steam cylinder. The bell hangs in the center of the mud cylinder and die, with its bottom flush with the bottom of the cylindrical part of the die. Inside the die, and even with the bottom of the bell, is a knife which travels in a circle and cuts the pipe to the desired length.

The socket former is a cast iron disk with holes perforated in its surface, and is equal in diameter to the inside diameter of pipe socket. It is fastened to the top of a vertical rod, and is held in place by means of hooks on the lower part of the die.

When the mud and steam pistons are at their upper limit, the socket former is put in place and the mud cylinder filled with mud; steam is admitted and the mud is forced by the mud piston and conical bell into the die. When the mud oozes through the holes of the socket former the socket of the pipe is finished. Then the socket former is released and it descends, and the straight part or body of the pipe is formed as the mud is forced out of the mud cylinder between the die and the bell. When of proper length the pipe is cut off by the knife.

All sizes of pipe can be made in the same press by changing the bell, the die, and the socket former. Curved pipe are molded by moving the bell slightly to one side, allowing the clay to be forced out faster on one side than on the other.

Junctions are deftly made by hand. A hole is cut in the side of the larger pipe by a knife, the smaller pipe is trimmed or mitered to fit it at the proper angle, and the joint is plastered up with clay. This is done while the pipes are green, and no pattern is used or measurements taken.

The pipe is next conveyed to a room heated by steam pipes, where it is set on spigot end to dry, remaining from 3 to 15 days, according to the weather.

When the pipes are perfectly dry they are stacked up in the kiln, spigot end downward, the small ones inside the larger ones. The bottom layer of pipe is set on extra rings provided for the purpose; otherwise they would be damaged by cracking. The kiln is essentially the same as the down-draft kiln used in burning farm tile, but the heat used is considerably greater. After the kiln is filled with pipe all doors are closed and the contents gradually heated, coal being used for fuel.

The time of burning depends upon the size of the kiln, kind of clay, etc., but usually is about five days. The temperature of the kiln and the progress of the burning are determined by means of small clay test pieces placed within reach in the kiln. When the pipes have nearly reached the point of vitrification, the heat is raised to between 2,400° and 2,500° F., and a shovelful of common salt is thrown in on the fire. This is repeated three or four times in an hour. The salt is volatilized in the presence of moisture, hydrochloric acid is disengaged, and the sodium unites with the silicon of the clay, forming with the silicate of alumina a fusible double alkaline silicate or glaze on the pipe. This glaze is a union penetrating the surface and forming part of the pipe instead of being a mere skin. For perfect glazing it is necessary that the salt be used when the temperature of the kiln corresponds to the temperature both of the fusion of the pipe and of the fusible condition of the glaze. Such glazing renders the pipe non-absorbent and impervious and gives it a smooth, slippery surface. A barrel or less of salt is used for a 20-ft. kiln, 15 ft. high. Sometimes a single dose of salt is used, much less than the preceding. Sweepings from packing houses are utilized. This finished, the fires are banked, and the annealing is effected by allowing the kiln to cool down slowly, requiring from four to five days.

In drying and burning, the various sizes of pipe shrink about 10% in length and 10% in diameter, so that each pipe is molded 5-48-in. larger per inch of diameter than its desired diameter.

In burning, under-vitrification is better than over. When overburned, blisters show on the surface, the material expanding and appearing in layers and the pipe becoming rotten. If underburned, the pipe has the appearance of clay.

The following table is given as representing the usual list prices of manufacturers. The discounts are usually as much as 75 or 80% on pipes not over 12 ins. in diameter, 70% on 18-in., and 60% on 24-in. pipes, when bought in car lots. Twelve-in. pipe costs, then, about 15 cts.; 18-in., 45 cts., and 24-in., $1 per ft.

List Price of Vitrified, Salt-Glazed Sewer Pipe.

Inside diameter, ins.	Straight pipe, per ft.	Curves and elbows, each.	Weight, per ft., lbs.	Area, sq. ins.	No. ft. in carload of 12 tons
3	$.15	$.50	7	7	3,400
4	.20	.60	9	12	2,700
5	.25	.75	12	19	2,000
6	.30	1.00	16	28	1,500
7	.35	1.25	20	39	1,200
8	.40	1.50	25	50	1,000
9	.50	1.75	27	64	800
10	.60	2.10	32	78	730
12	.75	2.75	41	113	600
15	1.00	3.75	60	177	400
18	1.50	4.75	85	254	280
21	2.00	6.75	105	345	230
24	2.50	8.00	140	455	170

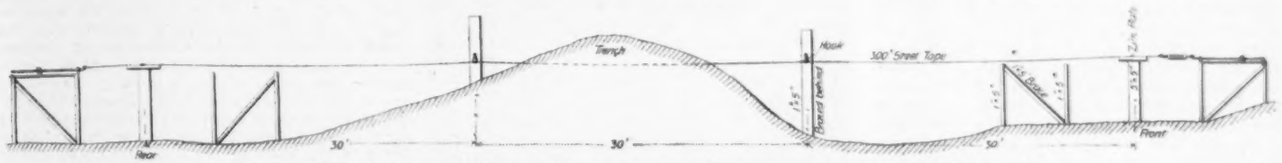
THE SURVEY OF ROANOKE, VA.

Our readers will remember that some months ago (Jan. 9, 1892) we published an ordinance providing for the official survey for the city of Roanoke, Va., together with a description of the method of carrying on the work as far as it had been completed at that time. Both the plan of the survey and the method of carrying it out are of especial interest as exceedingly good examples of what is essential and what is unessential in work of this kind, and of the possibility of doing a high quality of work at a very moderate cost. As was stated at that time, the credit of devising this plan is due to Mr. Wm. M. Dunlap, City Engineer, who has had full supervision of the work, with Mr. Geo. P. Wood as the engineer in charge of the survey. From a paper read before the Association of Engineers of Virginia by Mr. Wood we are enabled to abstract the following details in addition to those already published.

It will be remembered that the ordinance provided for three separate surveys: (1) A general triangulation of the ground; (2) a skeleton survey based upon this triangulation, to locate points from which a detailed survey could be made, and (3) the detailed survey itself. A very complete description of the triangulation, together with a map of the completed survey, was given in our issue of Jan. 9. In addition to this description, however, the following details of the methods adopted to secure accuracy in the measurements of the base lines are of interest:

Three base lines situated at the extremes of the main system of triangulation were measured, two 300-ft. steel tapes being used for the purpose. Several measurements were made of each base, nearly all during gentle rainstorms, the temperature, which was nearly constant, being noted to the nearest half degree Fahrenheit. The tapes during the measurement were suspended by hooks at intervals of 30 ft., and were subjected to a tension of 16 lbs., applied by means of a screw, and measured with spring balances. The intermediate supports consisted of narrow boards driven into the ground and braced, having smooth faces slightly at one side of the vertical plane of the base. Into this face a small screw was driven, the height of the hooks above grade, which was given to the nearest hundredth of a foot. The marking, or 300-ft., stations consisted of 5×5 in. posts, firmly braced, on which were spiked planks with pieces of sheet zinc, on which to mark with a blade the position of the end of the tape. Fig. 1 shows the arrangement of the tape and supports. Great care was taken to secure nearly perfect alinement, both vertical and horizontal. The grades ranged from horizontal to nearly 10%. The east and west bases were about 3,000 ft., and the south base about 1,000 ft. in length. A single measurement of one of the longer base lines required about one hour. After correction for temperature and reduction to the horizontal, there was found to be a difference of only a few thousandths of a foot between the different measurements of the same base.

The instruments used for the measurements of the angles and for the general purposes of the survey were high grade engineer's transits, with verniers reading to 30" on the horizontal, and 1' on the vertical circles. The telescopes had fixed stadia hairs



F.G. 1. METHOD OF SUPPORTING STEEL TAPE IN MEASURING BASE LINES, ROANOKE SURVEY.

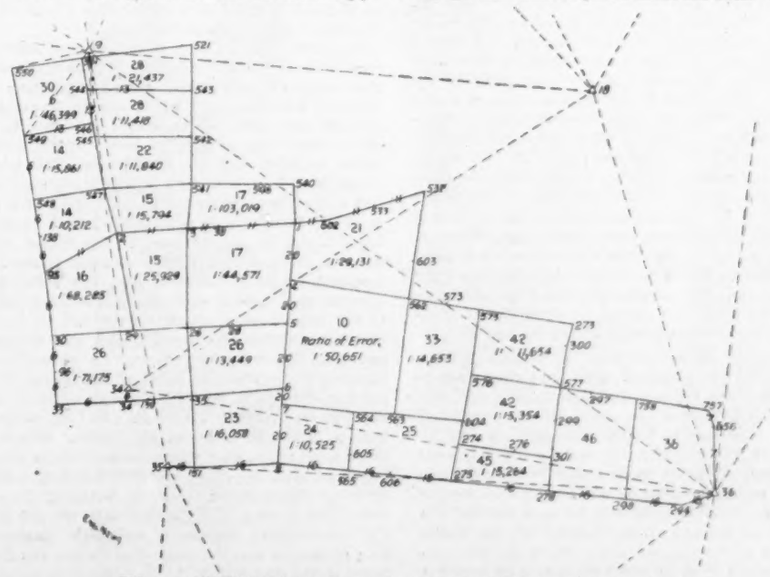


FIG. 2. SKETCH OF PART OF SKELETON SURVEY, ROANOKE, VA.

and levels attached. The targets were of pine, octagonal in section with 1¼-in. faces, and 6 ft. long. The bottoms were turned to points in a lathe, and the faces were painted alternately red and white. To assist in locating the targets small red and white flags were attached to their tops.

Following the triangulation, and based upon the data thus obtained, came the skeleton survey for the purpose of locating such points as were necessary in making a detailed survey of the property lines and streets. (A section so surveyed is shown in Fig. 2.) In this survey the stations were marked by hubs driven about 1 ft. below the surface of the street, and referenced and numbered. The angles were repeated and adjusted. The distances were measured, as were the base lines of the triangulation system, with modifications and less care.

The hubs in earth were of sound oak 2½ × 2½ ins. × 1 ft., with a copper tack to represent the point, and in rock were of steel 1½ × 1½ ins. × 1 ft., with the tops slightly upset and bottoms pointed. The points were represented by ⅛-in. holes punched in the tops. They were referenced by measuring the distance to three prominent objects not in a straight line, and the distances were recorded on a sketch of the location. The hubs were usually driven without reference to any line, near intersections of streets, near important objects, or wherever necessary on account of obstacles in the way of vision. The triangulation stations were also used as skeleton stations. With the exception that ⅝-in. octagon steel rods were used for targets, that the angles were not measured in pairs, and that they were all repeated twice, direct and reverse, the angles were observed and recorded in the same manner as were the triangulation angles. In the measurement of distance the transitman with a foresight and telescope direct gave the head tapeman line. The rear tapeman held the end of tape on a level with the surface of the ground directly over the instrument plumb bob, or, after moving up, on a mark representing a tape length. He also observed the temperature, took all pluses and kept a record of them for a check on the transitman. The head tapeman with rod at end of tape, which was drawn taut and nearly parallel with the surface of the street, received the line. A stake was driven deep enough to be firm. Then with a steady pull, measured by spring balances in the hand of the head tapeman, the tape was stretched over the stake, which received a mark under the 100-ft. mark on the tape. The final plus was taken with the use of a plumb bob. The transitman, with telescope level, read the level rod, first on the ground at the instrument and afterward on each support, and kept a complete record. There were often many intermediate supports on account of the irregularity of the ground. Continuous levels were not run, the only requirement being to know the difference of elevation of adjacent supports. The tape used being narrow, the wind had little effect upon it. The condition of the weather, whether it was clear, cloudy or windy, was recorded to aid in locating errors, should any exist. The method of keeping the notes was unusually complete, but beyond this is not worthy of especial note. In the office all notes were reduced and copied in ink in books especially arranged for that purpose. The discrepancy found by adding up the angles about any station, if not larger than allowable, was divided equally among the angles.

For use in the reduction of the distance notes a special table was prepared. This table gave the horizontal distance for one tape length, and for each tenth of difference of elevation. Barlow's tables of squares from one to 10,000 were used for the reduction of fractions of a tape length. The corrected angles and distances were transferred to a large book in which the stations are arranged in regular order, five lines being allowed for each station. On one side of the page were recorded all the angles measured at the station; on the other, the distances of the station from all other stations with which it is connected. This, of course, necessitated a double entry of all distances. To avoid carrying and multiplying errors of direction and distance the bearings, latitude and departure of zigzag lines connecting triangulation stations were first computed, thus cutting the system up into small parcels, thereby greatly simplifying the process of checking. Next the latitude and departure of the blocks or small closed figures, usually four sided, were computed. These traverses were computed upon printed forms which were numbered in regular order, a corresponding number being placed upon a working diagram. Finally when the latitudes and departures had been properly adjusted, all the information will be recorded in a special book. This book will contain for each station the length and bearing of all lines connecting it with other stations, together with the corresponding latitude and departure, corrected latitude and departure, co-ordinates of the station, ranges and section numbers, which refer to the detail survey, and the numbers of the traverse sheets on which the lines appear.

For use in the detail survey now in progress an index map has been prepared on which is shown, in contrasting colors, the corporation divided into ranges and sections. These sections are about 800 × 1,300 ft., and are bounded by streets and alleys when practicable. Roman letters denote the ranges and Arabic figures the sections. Each section covers an area to be plotted upon the corresponding sectional or detail map. From the county and corporation deed books abstracts of all deeds conveying real estate, wholly or in part within the corporation, are copied upon printed forms. With the aid of the index map these forms receive on face and back the range and number of the section in which the property thereon is situated. The form is folded and placed in a file case with compartments corresponding to the sections. Should the property in question be situated in more than one section a copy of the abstract is generally made for each.

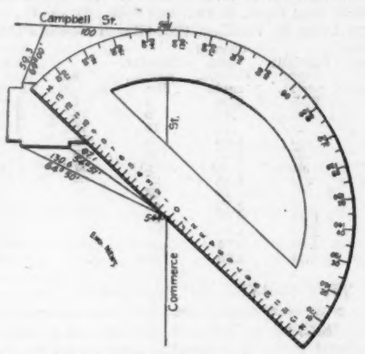


Fig. 3. Method of Using Combined Protractor and Scale.

The field party at work on the detailed survey is required to locate with reference to lines of the skeleton survey all hubs or stakes used in previous surveys, all buildings over 10 ft. square, lamp posts, electric light poles, trees within the streets, fire plugs, water mains, manholes, sewer outlets, natural water courses, railways and fences. The instruments used for this work are the transit, steel rods and a steel tape, graduated to hundredths of a foot from the forward end and attached to a frame in which it can be quickly wound. The transit is set up on a skeleton line, vernier clamped at zero. A foresight is taken on same line, the lower limb clamped and vernier unclamped. Then the angles to the salient points of the object can be turned without resetting the vernier, and the distances measured from the instrument. An especially interesting and noteworthy detail of this survey is the plotting of notes in the field to a scale of 30 ft. to 1 in. For this purpose a case 22 × 18 ins., mounted upon a light tripod, serves as a table. Sheets of tough detail paper, upon which the skeleton lines have been plotted in the office, are fastened to this table by being slipped under the metal straps at the corners. The plotting is performed with the aid of a 180° rectangular protractor and scale combined. This protractor and the method of its use are illustrated in the sketch, Fig. 3. In addition to the plot, all distances and angles are recorded upon the proper lines. The notes are plotted upon the detail maps in precisely the same manner as in the field, but with more care and finer instruments. Upon the finished detail maps the property lines described in deeds will be plotted. Just what method will be used for this work has not been determined.

In accordance with the systematic manner in which the whole survey is being carried out, a comprehensive system for naming the streets and numbering the houses, devised by the City Engineer, has been adopted by the city. The houses are to be numbered on the usual centenary plan. The city is to bear all the expense of numbering, and suitable penalties are imposed for a refusal to let this work be done. The plan for naming the streets is very plainly given in the ordinance, which we quote as follows:

"The intersection of the middle of the main line of the Norfolk & Western R. R. and Jefferson St., as now known, shall be considered the central point of the city, thus forming the four quadrants, to be styled 'Northwest,' 'Northeast,' 'Southeast' and 'Southwest' divisions. Jefferson St. shall continue to bear the name. From the said Norfolk & Western R. R., running north, the said street shall be known as 'Jefferson St., north,' and from the said railroad, south, it shall be known as 'Jefferson St., south.' All streets running in a general direction, east and west, shall be called avenues and named, and all streets running in a general direction north and south, shall be called streets and numbered. All streets in the city having an eccentric course, shall receive the special name of 'Road' or 'Boulevard;' and the names of the streets and avenues as shown on the map, attached to this ordinance and ordered to be copied in the books of the Engineer of the city of Roanoke, shall be the true name and designation of said streets and avenues."

In carrying out the survey certain limits of allowable error have been maintained. The angles about a triangulation station were required to sum up to within 20″ of 360°, and about a skeleton station to within 1′ of 360°. The error of closure in the zigzag traverses of the skeleton system, where a triangulation line completed the circuit, was limited to not more than one in 10,000 to the length of the zigzag line. In the skeleton traverses proper an error of closure larger than one in 10,000 was not allowable.

In closing his paper Mr. Wood calls attention to the desirability of carefully numbering all lots for convenience in keeping the records, and says:

"An ordinance needed for the welfare of the city as well as for the preservation of the map, is one to prohibit the sale of lots fronting upon new streets until the location of such street has been approved by the city authorities. By this means some regard will be paid to proper connections with other streets, to symmetry and to cost of construction and maintenance. If the city is to support its streets it should at least have a voice in their location."

The force of this statement will be appreciated by anyone who has ever had occasion to make surveys for improvements on new streets in partially built-up sections of a city.

The cost of the survey up to April 1, 1892, at which time the triangulation had been completed, was as follows:

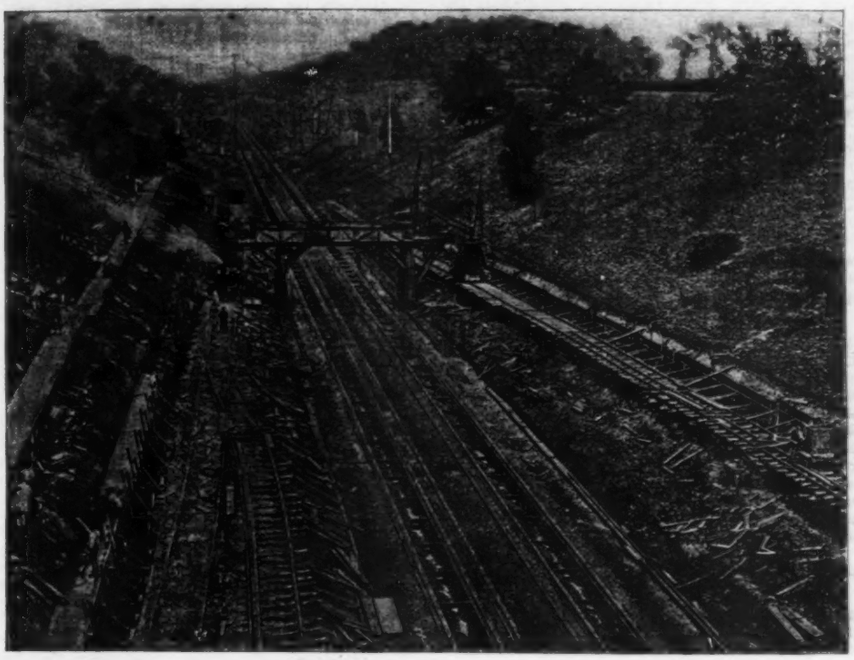
Triangulation survey,	field work		$579.48
" "	office work		386.00
Skeleton "	field work		1,527.03
" "	office work		920.68
Detail "	field work		715.29
" "	office work		346.64
Copying and filing abstracts of deeds			693.69
Instruments, material and incidental expenses			1,814.84
Total			$6,983.65

The cost of material used in the triangulation was given in our previous article as $172.50, making the total cost of triangulation $1,138. The area covered by the survey is about 6,000 acres, which makes the cost of triangulation less than 20 cts. per acre.

THE WIDENING OF THE GREAT WESTERN RAILWAY, ENGLAND.

The increase of traffic on several English railways has necessitated the four-tracking of some parts of the lines, particularly in the neighborhood of London, and we give the following particulars of the widening of the Great Western Railway, which are abstracted from an article in "Engineering," of London. This road has already about 20 miles of four-track in operation on its main line from London to the West of England (Eng. News, Feb. 21, 1891), and work is now in progress between Maidenhead, 24 miles from London, and Didcot, 53 miles, or a length of 29 miles. Our illustration represents the work of widening in a deep cut a short distance east of Reading. The cut is through a treacherous clay, and in order to interfere as little as possible with the slopes, the foot of the slope on each side has been cut away and a concrete retaining wall built. The cut is 1.75 miles long, and the walls have been built about half the length, at the deepest part. The

walls are 8 ft. 6 ins. to 18 ft. 3 ins. high, 3 ft. wide on top and 6 ft. 10 ins. to 8 ft. 4 ins. wide over the footings. The front face has a batter, but the back is vertical. As work is being carried on at both sides



FOUR TRACK WIDENING OF THE GREAT WESTERN RAILWAY, ENGLAND.

(The Present Tracks Have the Mixed Gage of 7 ft. and 4 ft. 8 1-2 ins., with Rails on Longitudinal Timbers.)

of the track, two traveling bridges are used for the transfer of material.

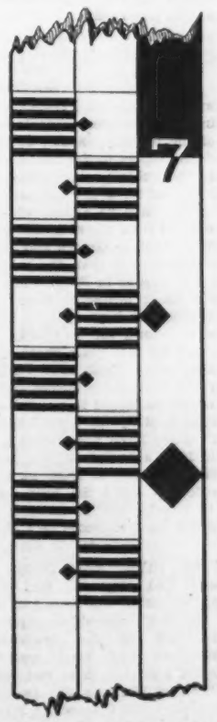
Steam excavators are used in the widening of some of the cuts which pass through the chalk formation. Large numbers of bridges have had to be altered, those under the track being widened and those over the track being lengthened. In some cases the picturesque old stone and brick arch bridges over the track, which were built in Brunel's time, have been replaced with iron structures, but where deep cuts have been crossed by three-arch bridges, the abutments have been underpinned, slopes excavated, and a track laid through each side arch. Single-arch bridges have in some cases had the abutments strengthened and side arches built across the widening to new abutments. The railway company deserves praise for its action in deciding to follow the existing style in widening Brunel's famous bridge which carries the railway over the Thames at Maidenhead. This is a brick structure, and was built about 40 years ago. It consists of two main elliptical arches of 128 ft. span and 23 ft. 3 ins. rise. Beyond these, on each side, are four semicircular arches, one of 21 ft. and three of 28 ft. span, and these are followed by four narrow arches carrying the bridge back to the bank. The four-track work will be completed for the entire distance of 53 miles by next winter.

The peculiar appearance of the truck shown in the cut is due to the fact that this part of the line has the mixed gage of 7 ft. and 4 ft. 8½ ins., laid with bridge rails upon longitudinal timbers (Eng. News, Feb. 21, 1891). The broad gage was finally abandoned on May 20, 1892, when the last regular through train was run over the road, and the sections having the broad gage only, about 200 miles altogether, were changed to standard gage on May 21, 22. On the mixed gage part of the line the broad gage will be used occasionally until all the rolling stock is changed, and the removal of the outer rail and necessary alterations to the track can be proceeded with at leisure.

A NEW STADIA AND LEVEL ROD.

We are indebted to Mr. Geo. F. Wright for the accompanying sketch of a self-reading stadia or level rod, originally designed for stadia use only, but which has proved to be a very good rod for level work also. For the latter purpose the numbers are placed in the blank tenths, 0.05 ft. in length.

The feet are marked in solid colors, alternate black and white, marked by a diamond at the half and quarter foot. Each tenth is divided into hundredths, as shown in sketch, with a small diamond at



Stadia and Leveling Rod.

each half-tenth. The best size was found to be 2½ to 3 ins. wide, made of sugar pine, tapered in thickness from 1½ in. at bottom to 1 in. at top, with metal shoes at top and bottom. The marking is better protected by channeling the middle sections, so as to leave a shallow bead on each side 3-16-in. wide. The practical advantages claimed for the rod are:

1. The solid marked feet enable the observer to read the number of feet between the wires at any distance practicable for observation.

2. The alternate arrangement of the subdivided tenths renders it very simple to read the tenths and hundredths instantly, when not too far off to distinguish the subdivision.

3. When the rod is too far from the observer to render the subdivision into hundredths useful, the subdivided tenths assume the appearance of a solid black and can be counted, and subdivision by the cross wire estimated at the full distance of practical observation.

The rod was designed in 1873 by Mr. W. M. R. French, then of Cleveland & French, of Chicago, and by Mr. Geo. F. Wright, then in charge of a branch office at St. Paul, Minn., who adds in his letter: "I have used the rod since that time, in connection with other rods of almost every conceivable style of marking, and have seen none which can be plainly read to the lowest subdivision within about 200 ft. of equal distance with this rod. For those who use the stadia much this increase of range is valuable."

WORLD'S COLUMBIAN EXPOSITION.

Expenditures on Construction Contracts.

A report recently made to the Board of Directors by the auditor, Mr. Ackerman, gave an interesting statement of the amount of each of the contracts for construction work, and the amount paid on each up to May 31, 1892. This statement is as follows, and for the two items marked with a star the amount is returnable by the city of Chicago:

Contracts let.	Amount of contract.	Paid to May 31*
Mines and Mining Building	$156,687.71	$217,887.12
Electricity Building	424,501.61	297,670.91
Galleries of Fine Arts	466,976.00	174,922.75
Art Building, Lake front	200,0.0.00	.....
Manufactures and Liberal Arts Building	1,568,321.80	714,421.36
Transportation Building	288,478.53	214,343.17
Machinery Building	1,119,385.00	393,560.40
Administration Building	436,196.96	208,538.28
Agricultural Building	673,914.32	387,133.22
Forestry Building	72,892.00	52,565.44
Woman's Building	130,232.60	97,710 42
Horticultural Building	253,294.48	231,201.27
Fisheries Building	182,640.40	127,020.82
Propagating house	3,201.00	.....
Pumping station	21,237.23	9,908.00
Well and conduit	6,08:.00	5,280.80
Dairy Building	25,184.60	18,286.25
Fencing	11,204.93	8,425.00
Water pipe and laying	153,635.10	131,549.84
Water tank for locomotive and railway material	71,794.94	62,573.02
Roadways and sidewalks	29,250.00	.....
Iron bridges	15,900.00	.....
Grand fountain	56,000.00	26,000.00
*Pumping works, city of Chicago.	200,000.00	171,229.85
*Police barracks, city of Chicago.	60,000.00	10,125.00
Fire engine house and hydrants	11,190.00	3,690.00
Fire and police alarm system	9,000.00	.....
Hose and hose reels	60,545.00	8,435.00
Statue of the Republic	8,000.00	1,500.00
Sculpture models	2,800.00	2,000.00
Piling around interior waterways	62,9.0.00	57,933.57
Facing docks of lagoon	4,970.00	3,985.00
Finishing terraces and interior docking	69,923.00	.....
Sewage ejectors	65,800.00	11,520.00
Ejector pits and stop gates	19,226.00	.....
Surface drainage	25,000.60	20,100.63
Roadway drainage	58,086.00	8,490.31
Cast iron pipe	35,000.00	.....
Wrought iron pipe	3,306.50	.....
Iron sewer and air pipe, etc	13,118.50	.....
Rent of land	65,000.00	8,905.00
Subways for electric wires	35,094.40	22,975.55
Electric power	8,000.00	.....
Arc lights	105,000.00	.....
Board of architects	128,000.00	94,497.80
Office of grounds and buildings	5[illegible],310.10	13,127.00
Boiler plant	64,600.00	.....
Music-hall, Casino and Peristyle	279,730.00	.....
Building for floats	10,389.00	.....
Floats	91,360.00	10,000.00
Pyrotechnic display	25,000.00	.....
Miscellaneous	50,000.00	.....
Total	$8,123,861.29	$3,787,556.90

PERSONALS.

Col. Wm. H. Stevenson, Vice-President and General Manager of the Housatonic R. R., has resigned.

Mr. Wm. Findlay, Master Mechanic of the Brooklyn & Brighton Beach, has been appointed Superintendent, vice Mr. J. Morrow, deceased.

Mr. T. C. McNeely has been appointed Superintendent of the Main Stem Division of the Central R. R. of Georgia, vice Mr. H. R. Dill, resigned.

Mr. J. L. Greatsinger, General Manager of the Duluth & Iron Range R. R., has been elected President, retaining also the position of General Manager.

Mr. C. M. Levey has been appointed Superintendent of the Iowa lines of the Chicago, Burlington & Quincy R. R., vice Mr. C. G. Wilson, deceased. His office will be at Burlington, Ia.

Mr. F. S. Odell, M. Am. Soc. C. E., has been appointed Commissioner of Public Works at Mount Vernon, N. Y. He has been engaged for some years in municipal engineering.

Mr. Alexander von Babo, Civil Engineer, has opened an office in the Monadnock Building, Chicago, as the American representative of Siemens & Halske, electrical appliance manufacturers of Berlin.

Messrs. C. H. Wright and J. H. Nair have formed a copartnership under the firm name of Wright & Nair to carry on an engineering and surveying business, with office in the Ashland Block, Chicago.

Mr. F. A. Bartholomew, President of the Riley Elevated Ry. Co., died at Boston, Mass., June 12. He had been actively engaged in the endeavor to secure the introduction of the Riley system in Boston.

Mr. Gabriel Baross, Minister of Commerce of Hungary, who originated the railway zone tariff system in that country, died recently at the age of 44. It was at his instance that the government completed the state railway system by the purchase of the private lines.

Mr. John W. Hill, co-editor with Mr. Angus Sinclair of that excellent new periodical, "Locomotive Engineering," sails for Europe this week on a summer vacation trip. He will be absent most of the summer.

Mr. L. E. Sangdahl has resigned his position with Keepers & Wynkoop to accept that of Chief Engineer of the Milwaukee Bridge & Iron Works, Milwaukee.

Mr. Patrick Casey, a railway contractor well known in the West, died at Chicago, on June 15. He was born in Ballovan, Limerick Co., Ireland, in 1819, and came to America in 1837. With his brothers he built the Illinois & Michigan Canal, the Chicago & Galena R. R. from Urbana south.

Mr. Charles W. Sherman has opened an office in Binghamton, N. Y., for the practice of civil engineering. Until this week he has been instructor in civil engineering in Cornell University, Ithaca, N. Y.

Mr. John E. Hill, Assoc. M. Am. Soc. C. E., recently instructor in civil engineering in Cornell University, sailed June 20, for Brazil, to make plans for sewerage of Sao Paulo and Santos, Brazil.

Mr. John Whitelaw, Superintendent of Water-Works, Cleveland, O., died June 16. He was born in Cleveland in 1831, and was educated as a civil engineer. At a comparatively early age he entered the City Engineer's office, and in 1859 became City Civil Engineer. He filled this position for eight years, and in 1867 resigned to accept the office of engineer of the water-works, under a separate board. In this position he became widely and favorably known ,and he held it until his death. His public service covered a period of 37 years, and his knowledge and integrity were without question. Mr. Whitelaw was a prominent member of the Civil Engineers' Club, of Cleveland, and was twice elected president. His 25 years' service in connection with the Cleveland water supply represented a period of great growth and development, and a virtual reconstruction of the original system. Under his management the two new high service reservoirs were built, also the lake tunnel and crib.

In the reorganization of the city government in 1891 under the so-called Federal plan, his office became a bureau or department under the Director of Public Works, instead of being controlled by an elective board, but his abilities were so fully recognized that his reappointment was a matter of course. He was a man of considerable courtesy of manner, and stood high in all relations of life.

Sir James Brunlees, Past President of the Institution of Civil Engineers, died at Wimbledon, near London, June 2. He was born at Kelso, Scotland, in 1816, and was educated at the Edinburgh University. After serving a regular term as pupil under Mr. Alex. J. Adie, he in 1838 became assistant engineer to Mr. Adie on the Bolton & Preston Ry. Subsequently he was resident engineer for five years on the Lancashire & Yorkshire Ry., under the late Sir John Hawkshaw, and then went into business on his own account. He was elected a Member of the Institution of Civil Engineers in 1852, and was President in 1883. He was knighted six years ago, and had received from the emperor of Brazil the decoration of the Order of the Rose. He was engineer for several of the smaller railways in England, on some of which there was very heavy work, as the crossing the tidal estres of the Kent and Leven rivers and the shifting sands of Morecambe Bay, on the Lancaster & Ulverston Ry. He also built the docks at King's Lynn, Whitehaven and Avonmouth, the latter 1,400 × 500 ft., with a maximum tidal rise of 44 ft., and in connection with this dock he built the Clifton Extension Railway, which gives it railway communication with the port and city of Bristol. In Brazil he built the San Paulo Ry., with grades of 10%, operated by cables, to pass the summit of the Serra do Mar, and the Minas & Rio Ry., which has a 3% grade 18 miles long. He was also engineer of several other railways in South America. He was engineer for the Mont Cenis Ry., which was a switchback line crossing the mountains before the tunnel was built. It had grades of 4 to 8.3%, and was operated on the Fell center-rail system. Among his other great works was the Mersey Tunnel. He was joint engineer with Sir John Hawkshaw for the proposed channel tunnel between England and France.

NEW PUBLICATIONS.

CONNECTICUT ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.—Proceedings of meetings held June 10 and Sept. 3, 1891, and Jan. 12, 1892. 8vo., pp. 35.

The principal part of this pamphlet is occupied by a paper on "Sewage Disposal by Irrigation and Filtration through Land," by Mr. T. H. McKenzie.

THE PROPOSED SHIP CANAL BETWEEN PHILADELPHIA AND NEW YORK.—Pamphlet. 8vo., pp. 22.

This pamphlet contains addresses made by Prof. L. M. Haupt, Mr. Thomas Martindale and Mr. Erastus Wiman, on the proposed ship canal between Philadelphia and New York, via Trenton, connecting lower Raritan Bay with the Delaware River. The addresses were made at the annual meeting of the New York Board of Trade and Transportation in January, 1892. Prof. Haupt showed that such a canal would reduce the distance by water between New York and the coal fields, and should reduce the cost of transportation of coal about 50 cts. per ton. Some of the naval vessels could pass through.

TRADE PUBLICATIONS.

COMPOUND LOCOMOTIVES.—Schenectady Locomotive Works, Schenectady, N. Y., 8vo., pp. 44, illustrated.

This pamphlet is devoted to a description of the two-cylinder compound locomotives which are made a specialty by the Schenectady Locomotive Works, and some of which were described and illustrated in our issue of April 28. The engines are of all types and adapted to all classes of service, and have shown an economy of 15 to 30% over similar simple engines, together with reduced wear and cost for repairs. The intercepting valve used is automatic, and is the invention of Mr. A. J. Pitkin, Superintendent of the works. Particulars are given of the construction and operation of this valve, and of tests made of the engines. The illustrations include indicator diagrams, the intercepting valve, and views of several engines. The works have a capacity of 450 engines per annum.

SOCIETY PROCEEDINGS.

WISCONSIN POLYTECHNIC SOCIETY.—At the meeting at Milwaukee, June 13, President Benzenberg in the chair, Mr. W. K. Means presented some notes on the history of the bushel measure, based principally upon J. Q. Adams' report to the Senate in 1820. He was led to study the subject when asked to measure a large quantity of coal for a gas company. Although our bushel and gallon have no logical relation to each other, they are derived from the same Roman measure, which can be traced back to Greece and Babylon, and are one remove nearer to it than the present British measures. They first appear in English law in 1266, at which time the existing measures were defined and standards were thenceforth kept. Henry VII. made an ignorant attempt to reform the standards of capacity with the result that for 200 years there were five or six conflicting measures. About 1700 Parliament selected arbitrarily the Winchester bushel and the gallon of 231 cu. ins., which continued in use for over a century, and have been kept by the United States. Some of the individual states have had different measures. New York had, in 1850, a bushel slightly less than the imperial, and Massachusetts, in 1883, made a special coal bushel intended to equal the heap bushel. The latter quantity is largely left to custom; as far as United States law indicates, it should be 2,74.717 cu. ins.

M. G. Schinke, Secy.

INSTITUTION OF CIVIL ENGINEERS.—The annual meeting was held May 31, Mr. H. Hayter, Vice-President, in the chair. The report of the council for the session 1891-1892, stated, in regard to the changes in the roll of the Institution, that 59 Associate Members had been transferred to the class of Member, and that there had been elected 3 Honorary members, 28 Members, 324 Associate Members, and 7 Associates, while 4 Associate Members had been restored to the register. These additions altogether amounted to 366. After deducting 145 names from deaths, resignations and erasures, there was an increase of 221, bringing up the total number on the register to 5,371, as against 5,150 at the corresponding date last year. This enumeration was irrespective of the students, of whom 200 had been admitted during the year, against 166 for the previous twelve months; but during this period, 106 students had become Associate Members, and 140 had disappeared from the list, so that the number now on the books was only 868, whereas last year the number was 914. Thus, including students, the total number on the books is now 6,239, as against 6,064 twelve months ago.

During the financial year ending March 31, 1892, the receipts amounted to: Income, $100,355; other receipts, $30,585; making a total of $130,940, as compared with $121,370 for the preceding year. The total expenditures were $116,785. The lease of the house of the institution, 27 Great George St., has been purchased, this being deemed advisable, having regard to the question of rebuilding still under consideration. The several receipts have been invested in debenture stocks of British railway companies, of the nominal or par value of $35,000. The balances to the credit of the Institution at the beginning and at the end of the financial year were respectively $33,775 and $41,124.

The report further stated that allusion had been made on several occasions to the fact that, as the Corporation included all classes of civil engineers, it must be expected that the "Minutes of Proceedings" would be greatly modified and developed, so as to meet the wants of its more diversified membership. The report proceeded to show that these diversified requirements had been fairly well fulfilled by papers on civil, mechanical, mining, electrical and sanitary engineering, and general physics, which had been read and discussed as well as printed.

Having regard to these considerations, it would be found that in constructive engineering five papers have been read. Two of these—"The Bishop Rock Lighthouses," by Mr. W. T. Douglass, and "The Illumination by Gas of Tory Island Lighthouse," by Mr. D. C. Salmond—referred to sea coast works of supreme importance to every maritime nation. The three communications on "Portland Cement" and on "Portland Cement Concrete," by Messrs. Bamber, Carey, and Smith, related to a material fast becoming indispensable to the constructive engineer. Two papers directly connected with municipal engineering were submitted for discussion, namely, on "The Sale of Water by Meter in Berlin," by Mr. Henry Gill, and on "The Sewage Farms of Berlin," by Mr. H. Alfred Roechling. Both bore witness to the advanced condition of sanitary matters in the capital of the German Empire. The elaborate paper by Mr. Alex. R. Binnie, on "Mean or Average Rainfall," must also be classed with this branch of engineering, as referring to one of the data upon which the water-works engineer based his calculations. Mining and metallurgical engineering were represented by the paper on "Gold-Quartz Reduction," by Mr. A. H. Curtis. As the modern processes of ore-reduction were accomplished by the aid of machinery, the efficient conduct of the operations was directly dependent upon the engineer. In regard to mechanical engineering, the memoir on "Weighing Machines," by Mr. Wilfrid Airy, opened up entirely new ground, while that on "Petroleum Engines," by Professor W. C. Unwin, was mainly an exhaustive study of a particular machine. Electrical engineering was represented by a paper on "Electrical Measuring Instruments," by Mr. James Swinburne. Finally, reference was made to some questions of importance belonging primarily to the domain of physics, and which required to be attentively studied by engineers; especially was this the case in respect to the operations connected with the measurement of light and heat, dealt with in the papers by Mr. A. P. Trotter on "The Distribution and Measurement of Illumination," and Professor W. C. Roberts-Austen on "The Measurement of High Temperatures."

Among the papers which had been deemed suitable for printing without being discussed, those of Mr. F. Fox on "The Hawarden Bridge," and Mr. Alfred W. Szlumper on "The Widening and Improvement Works of the London & Southwestern Railway," belonged strictly to constructive engineering; closely related were "The Building Stones of Great Britain, Their Crushing Strength and Other Properties," by Professor T. H. Beare; "Stresses and Deflections in Braced Girders," by Mr. A. D. Stewart; and "Practical Astronomy as Applied to Land Surveying," by Mr. R. H. B. Downes. The description of "The Nagpur Water-Works Extension," by Mr. E. Penny, and of "The Southampton Water-Works," by Mr. W. Matthews, affected the municipal engineer; while mechanical and electrical engineering were respectively dealt with in the papers by Professor W. C. Unwin, on "The Transmission and Distribution of Power from Central Stations by Compressed Air," and Dr. C. P. Sheibner, on "The Florence & Fiosole Electric Railway."

The following officers were elected for the ensuing year: President, Harrison Hayter; Vice-Presidents, Alfred Giles, M. P., Sir Robert Rawlinson, K. C. B., Sir Benjamin Baker, K. C. M. G., LL. D., F. R. S., and Sir Jas. N. Douglass, F. R. S.; other members of Council, W. Anderson, D. C. L., F. R. S., J. Wolfe Barry, Alex. R. Binnie, E. A. Cowper, Sir Douglas Fox, J. C. Hawkshaw, M. A., Charles Hawksley, Sir

Bradford Leslie, George Fosbery Lyster, James Mansergh, Sir Guildford L. Molesworth, W. H. Preece, Sir Edward J. Reed, Wm. Shelford and Francis W. Webb.

THE IRON AND STEEL INSTITUTE. (From our London Correspondent.)—The annual meeting was held in London May 26th and 27th. There has been a falling off in the prospects of this institution during the last year, so far as membership is concerned, the increase being represented by a unit. The balance sheet shows the funds to be in good condition, but finance depends on membership, and if the latter falls away the other is sure to follow.

There was not a very good audience to listen to and discuss the papers read, but among the well-known members present were: Sir Henry Bessemer, who occupied his usual seat on the President's right hand; Sir Lowthian Bell, Mr. James Riley, General Manager of the Steel Co. of Scotland; Dr. Riley, Mr. Martin, of Dowlais; Mr. Hadfield, Mr. Stead, of Middlesboro, and Mr. Snelus were those present. The President, Sir Frederick Abel, occupied the chair throughout.

The following is a list of the papers: "Experiments with Basic Steel," W. H. White, F. R. S., Director of Naval Construction: "The Production of Pure Iron in the Basic Furnace," Col. H. S. Dyer; "Experiments on the Elimination of Sulphur from Iron," E. J. Ball, Ph. D., and A. Wingham; "Platinum Pyrometers," H. L. Callender; "The Manufacture and Application of Chilled Cast Iron," E. Reimers, Magdeburg; "Valves for Open Hearth Furnaces." J. W. Wailes; "The Calorific Efficiency of the Puddling Furnace," Major Cubillo, of Trubia Arsenal, Spain; "A Practical Slide Rule for Use in the Calculation of Blast Furnace Charges," A. Wingham; "Notes on Fuel and its Efficiency in Metallurgic Operations," B. H. Thwaite.

Mr. White's paper, which was taken first, was the most important contribution, from a practical point of view, to the English steel maker. In this country we have unlimited supplies of iron ore suitable for working with wrought or cast iron; but a very small quantity that will serve for steel making. For this reason, by far the larger part of the ore used for the latter purpose has been imported from Spain, and this, of course, is undesirable. Efforts have been made to localize the steel making industry at Bilbao, near the large deposits of hematite, and a large ship building yard has also been established there; although, it may be added, with a conspicuous want of success. It might be, however, that an awakening of the Spanish Government might lead to a prohibition of the exportation of ore in order to foster a local industry. No doubt, that would be a bad policy for a time; but a vigorous government might work it in order to secure ultimate benefit. There is, however, little prospect of anything very vigorous being done by the Spanish Government, and ready money is too scarce in the peninsula for there to be need of much fear that any means of producing it will be checked in favor of a distant prospective advantage. Nevertheless, it is undesirable that Great Britain should continue dependent on a foreign source for the raw material of one of her most important industries, and that is why the basic process should have been a subject of national concern instead of being kicked and reviled in the way it has been, for by the basic process it is essayed to use in steel making the deposits of more or less phosphoric ore, which are useless for the purpose if treated on the old acid system, either in the converter or the open-hearth furnace. The basic process has been before the world some years now, but its introduction to the ship building trade was unfortunate. As was natural, the northeast coast of England, near where the great Cleveland iron fields are situated, was the first district to take up the manufacture. A large quantity of basic steel was manufactured into slip material, and this turned out a lamentable failure. The consequence was that basic steel was tabooed everywhere; a sort of panic set in. Those interested in the basic steel patents did what they could to stay the flood of detraction that fell upon the unfortunate metal, but at first with little effect. In the meantime, the German steel makers looked with calmer eyes on the situation, and went quietly to work to develop the process. The success has been marked, and for a time German basic steel was used in English ships to some extent, although, perhaps, not to a large extent. The efforts of the owners of the basic patents to rehabilitate their metal have lately met with a considerable measure of success. A ship was commenced which was to have been built wholly of basic steel. The angles for the framing were rolled and tested by Lloyd's Registry, with very good results. The plates, however, were not made, and the idea has, it is believed, now been abandoned. Amongst other steps taken was an invitation to the admiralty to make exhaustive experiments with basic steel, and a large number of test pieces were supplied for the purpose. Mr. White's paper is the outcome of this; and in it he gives very fully the results of the experiments which were carried out in the royal dock yard at Pembroke. It would be useless to attempt to condense an epitome of the tables in which the details are given within the limits of this report, but it may be said, generally, that basic steel has been proved to be a reliable material; that is, so far as the samples submitted to the admiralty are concerned, but it would have been more satisfactory had Mr. White's paper given details as to the ore from which the pig used was made. In that case we should have been able to judge what prospect there is of utilizing the Cleveland and other ores which produce a more or less phosphoric pig. The question whether the basic process will find its larger field of usefulness with the converter or the open-hearth furnace is one that arises in connection with the subject. The general opinion seems to lean toward the open-hearth furnaces, but when such authorities as Mr. J. D. Ellis, the Managing Director of John Brown & Co., of Sheffield, and Sir Alfred Hickmann, say they prefer the converter, it may well be concluded that the point is yet open, although, doubtless, both systems have their desirable features, according to the nature of the material required. In the samples of converter basic steel tested, one specimen had a tensile strength of 30.6 gross tons per sq. in., with an elongation of 26% in 8 ins. A sample of open-hearth basic showed 31.35 tons per sq. in. tensile strength, with an elongation of 26.2% in 8 ins. The tests of riveting are also very interesting.

The paper by Messrs. Ball and Wingham was interesting, but the experiments narrated are not yet brought to that ultimate stage which will enable them to be transferred from the laboratory to the works. The aim of the authors was to reduce sulphur in iron by sodium, and so far they have been successful, but the question is by no means settled for industrial purposes. Col. Dyer's researches, as set forth in his paper, are yet of a somewhat academical nature, although they may lead to considerable practical results. Pure iron, which he essayed to produce, is an unworkable substance, as we all know, but if we can get pure iron by a commercial process, we shall have a fair basis to work upon in producing the useful alloys—such as steel—and a greater measure of certainty will thus have been introduced. Col. Dyer has yet much to accomplish before this can be said to have been done.

The paper by Mr. Reimers is to be amended and further particulars added. It dealt with the Gruson system of casting, but the details of manufacture were so meager that the paper may be left unconsidered. Mr. Callender's paper was a valuable contribution, on a too much neglected subject. The electrical resistance pyrometer of Siemens loses much—one might often say all—its value from the fact that it changes its zero. This has been considered to arise from the molecular change in the platinum wires through heating and cooling. Mr. Callender shows, pretty conclusively, that the deterioration of the wire has been due to the clay cylinder on which the wire has been wound. This has affected the wire by alloying with the metal. Mr. Calender uses mica and gets over the difficulty. The remaining papers do not call for any special notice. The next meeting this year will be held in Liverpool.

MASTER CAR BUILDERS' ASSOCIATION.—The 26th annual convention opened on Wednesday, June 15, at Congress Hall, Saratoga Springs. About 100 members responded to their names. President Kirby in his opening address said that a prominent feature of the past year was the great progress made in the use of safety appliances. Only twelve years ago, at the convention held at Detroit, Judge Chipman, in his speech of welcome, said:

"It is just possible that some one of you might invent a brakeman who would not sue for damages for the loss of a finger, or a deadwood which would not crush a brakeman's arm."

Neither Judge Chipman nor his auditors had the least idea that on June 15, 1892, more than 200,000 freight cars would be equipped with couplers which couple together without the intervention of human fingers.

The Secretary's report showed a total membership of 298, representing 1,071,219 cars, an increase of 14 in the membership and of 79,635 cars represented. The total expenses of the Association during the year were $5,692, and the Treasurer's report showed $4,184 cash on hand, besides about $380 unpaid dues.

The President appointed various committees and the Secretary read letters from the Pratt & Whitney Co. announcing that the standard M. C. B. coupler gages were ready for immediate delivery, and from the Interstate Commerce Commission, acknowledging an invitation to be present at the meeting, and congratulating the Association on its work in the adoption of safety appliances. The report of the committee on "Joint Inspection" was read, but action on it was deferred.

It was voted unanimously that the expenses of members of the Arbitration and Executive committees be, hereafter, borne by the Association.

The question was brought up of how depreciation should be figured in settling for an old car body with new trucks in case of its destruction; also as to whether depreciation on a rebuilt car should be reckoned from the date of its original construction or the date of its rebuilding. After a long discussion it was voted that depreciation should be figured separately on body and trucks, but the question as to rebuilt cars and as to how much expenditure on a car was necessary to constitute a rebuilding was not acted upon.

At the afternoon session the report of the committee on "Air Brakes and Signal Instructions," was presented and discussed. The very important clause, fixing the travel of the brake piston at 4 to 8 ins., was, after much discussion, changed to 6 to 8 ins. The reasons for the change were several. In freight service some cars are likely to have pistons traveling the full length of the cylinder (12 ins.), and a greater variation in cylinder pressures will ensue if the variation is between 4 and 12 ins. than if it is between 6 and 12 ins. The most important fact, however, is that the leakage groove in the cylinder is 3 ins., and so pistons, which when tested under the full pressure, according to the rules, travel 4 ins., will travel considerably less in making an ordinary service stop, and may not cover the leakage groove. Then the engineer will find that some of his brakes leak off as soon as applied.

Some interesting points were developed in the discussion. Mr. Rhodes showed that the wear of cast iron shoes was by no means so great as to necessitate taking up the slack of the brake gear to 4 ins. One strong objection to the limitation of the piston travel to a variation of but 2 ins. is that with brakes hung low from the car body or truck bolster, a brake which is just right for a loaded car will hug the wheel when the car is unloaded. Although these methods of hanging brakes are generally acknowledged to be wrong, they are still in use on many cars. The wear of brakeshoes on the other hand does not vary the travel of the piston very rapidly. A shoe wear of ⅝ in. only varies the piston travel about 2 ins. The vote to change the limits of piston travel to 6 and 8 ins. was finally carried by a vote of 32 to 28.

The other criticisms made were of minor importance, although Mr. Waitt brought out the fact that the gage on the engineer's valve, which is supposed to show the train pipe pressure, really shows the pressure in the equalizing reservoir and is cut off from the train pipe when the engineer's valve is on lap. The method of testing the train pipe for leaks prescribed in the rules, therefore, really depended on leakage past the piston of the valve. This and another question as to the testing of brakes before starting down heavy grades were finally referred back to the committee for further consideration. At a later session of the convention the committee reported that inspectors should be instructed to take up the slack when a full application causes 8 ins. piston tavel in passenger service or 9 ins. in freight service. The slack in either case to be taken up so that the piston will travel between 5 and 6 ins. The testing of the train pipe for leaks, prescribed in the report, was stricken out and the method to be adopted was left to each road's judgment. The convention adopted the rules as amended for use during the coming year.

At the opening of Thursday morning session, a letter was read from the Secretary of the American Society of Railway Superintendents, inviting the Association to appoint two or more delegates to attend the next meeting of the Railway Superintendents and take part in their discussions. Similar invitations have been extended to the Roadmasters', Train Dispatchers and Master Mechanics' associations.

The committee on "Best Metal for Brake Shoes" reported that the time taken up by the more important matter of standard air brake tests had prevented them from carrying out the experiments which they had hoped to make.

The committee on "Freight and Car Frames" presented its report, published in our last issue. They were criticised for wholly neglecting to report on the relative merits of rigid and swing bolster trucks, which was the main question referred to them, and the report was referred back to them for further consideration.

The important report on "Wheel Guarantee" (see our last issue) was discussed at length, but the discussion was practically confined to whether an original defect or heating the wheel by sliding was the cause of comby and shelled out spots. Mr. Barr made the surprising statement that of the engine truck wheels which failed, about 40% are removed for shelled out spots, whereas only 17% of the passenger car wheel failures are due to this cause. The explanation he believed to be the severer service on the engine truck, and he considered shelled out spots to be due to an original small defect in the wheel, due to poor methods in the foundry. The discussion showed that considerable difference of opinion existed as to just how far the

severe usage was the cause of both comby and shelled out spots. Mr. Schroyer, however, stated that very hard wheels were generally the ones which shelled out. The discussion was finally closed to give place to the regular order of business, the revision of the Interchange Rules. At a later session it was voted to submit to letter ballot the proposition to change the term "flat by sliding" to "flat or comby by sliding," but the question of making an allowance to the wheelmaker for worn flanges was not acted upon.

The remainder of the morning, all the afternoon session on Thursday and part of Friday morning's session were devoted to this work. The Arbitration Committee advised several changes, some of them of considerable importance. The committee on Joint Inspection reported a set of supplementary interpretations of the Interchange rules, which would in some cases have made a considerable addition to the size of the book of rules. As usually happens, the general sentiment of the convention was almost invariably against the changes proposed. They had rather bear the ills they had than fly to others that they knew not of. The result of six hours or more of brisk discussion and a good deal of parliamentary and unparliamentary wrangling was to leave the rules pretty much intact. The most important changes were those concerning M. C. B. couplers. After paragraph 1 of section (u) of Rule 3, which reads, M. C. B. couplers, with such minor defects only as do not impair their efficiency or safety (will not be considered in bad order) the following list of permissible defects in couplers was added:

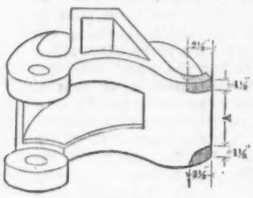


Fig. 1.

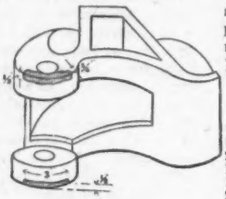


Fig. 5.

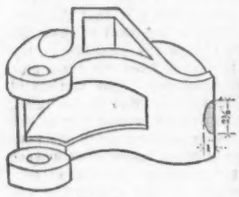


Fig. 2.

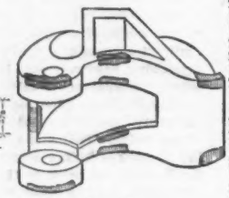


Fig. 6.

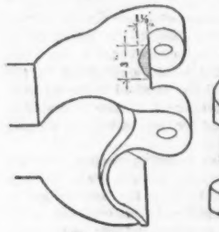


Fig. 3.

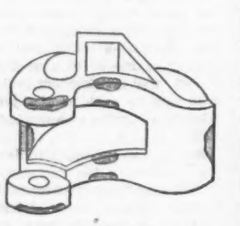


Fig. 7.

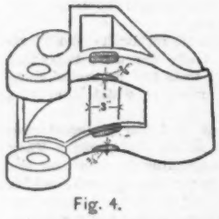


Fig. 4.

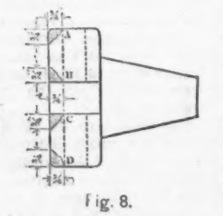


Fig. 8.

A. Chipped to 1½ ins. vertically, and 2½ ins. horizontally from outer edge of guard arm, provided not less than 5 ins. of metal is left intact on outer edge of guard arm A. See Fig. 1.

B. Chipped to 2½ ins. vertically and 1 in. horizontally in center of guard arm, provided both top and bottom corners are perfect. See Fig. 2.

C. Chipped on side wall to 3 ins. vertically and 1½ ins. horizontally, as shown in Fig. 3.

D. Chipped on front wall or center front face to 3 ins. horizontally and ¾ ins. vertically in top, bottom and throat as shown in Fig. 4.

E. Chipped on lugs in which knuckle swings, to ½ in. vertically, ¾ in. back and 3 ins. transversely, as shown in Fig. 5.

F. Having combination of chipped places with limits given above, as shown in Figs. 6 and 7, provided that defects shown in Figs. 1 and 2 do not together exist in the same coupler.

G. Having rib in front of locking dog bent inward, provided rib is chipped off so as to allow dog to drop into position.

H. Knuckles with lugs chipped to ¾ in. vertically and ¾ in. horizontally at A B C and D. See Fig. 8. These defects in knuckles are safe, but should be cared for.

On motion of Mr. Mitchell a section was added to the rules providing that a car with M. C. B. couplers may be refused in interchange if fitted with cast iron or malleable iron knuckles. Two other important changes concerning drawbars were carried, one providing in substance that one M. C. B. coupler may be substituted for another, in making repairs on foreign cars provided that defect cars shall be applied if any substantial change is made in the unlocking gear, the other related to repairs of link and pin drawheads, providing that any drawhead may be substituted for a link and pin drawhead and shall be credited for at its full value when removed and not credited only as scrap, as at present. The adoption of these two rules will greatly facilitate repairs to drawbars. An attempt was made at last year's convention to have the matter of repairs to link and pin drawbars simplified, but it failed of success.

Another addition of considerable importance in the rules was the adoption of a schedule of hours of labor to be charged for in making repairs. The schedule is as follows, and was of special interest as indicating pretty accurately the relative cost of different kinds of repairs:

Hours of Labor to be Charged in Making Repairs of Foreign Cars under the Rules of Interchange.

Piece or Pieces Replaced.	Refrig. cars. Hours.	Other cars. Hours.
1 side sill	44	38
2 " sills	63	53
1 " sill and 1 intermediate sill	50	44
1 " " " 2 " sills	67	50
2 " sills " 1 " sill	72	58
2 " " " 2 " sills	81	63
1 center sill	44	40
2 " sills	70	54
1 side sill and 1 center sill	70	54
1 " " " 2 " sills	93	79
2 " sills " 1 " sill	77	60
2 " " " 2 " sills	104	83
1 Inter. sill	40	29
2 " sills	55	36
1 " sill and 1 center sill	65	48
1 " " " 2 " sills	78	61
2 " sills " 1 " sill	71	53
2 " " " 2 " sills	88	66
1 side sill, 1 inter. sill and 1 center sill	79	61
2 " sills, 1 " " " 1 " "	100	75
1 " sill, 2 " sills " 1 " "	92	67
2 " sills, 2 " " " 1 " "	107	81
1 " sill, 1 " sill " 2 " sills	96	74
2 " sills, 1 " " " 2 " "	110	89
1 " sill, 2 " sills " 2 " "	106	81
2 " sills, 2 " " " 2 " "	120	94
1 side sill, splicing	15	12
1 Int. " "	14	11
1 side plate	42	42
1 running board	6	6
1 end plate	14	14
1 " sill under siding	15	15
1 " " outside "	7	7
1 " or corner post	3	3
1 door or side	3	3
1 platform plank	2	2
1 body bolster	10	8
1 crostie timber	3	3
1 draft timber	6	6
2 " timbers on same end	10	10
1 carlin	..	2
1 truck bolster	10	10
1 spring plank	10	10
1 truck bolster and 1 spring plank in same truck	12	12
1 brakebeam	2	2
1 drawbar	2	2

The uniform price for this time is by the miles, 20 cts. per hour, so that the whole table may be (and will be) converted into fixed money charges.

A change in the rule adopted last year which made owners of cars responsible for worn out brake shoes, journal bearings and some other repairs was generally expected; but the change made was much less sweeping than was expected. The brake shoe clause was only amended by requiring that no charge should be made for labor in renewing, and this only after a vote by cars had been called for and taken. In the rule concerning journal bearings worn out, a clause was added that an arbitrary scrap credit should be made to the owner of half the weight of the brass applied.

Several changes were made in the prices at which car bodies destroyed are settled for. Box car bodies 36 ft. long or over are credited at $325, and stock cars 34 ft. long or over at $300. The credit of $25 each for feeding and watering attachments in stock cars was changed to $20. Prices to be charged for material used in repairs were changed from 3 cts. to 4 cts. per lb. for malleable iron, from 16 cts. to 14 cts. for brass journal bearings and from 18 cts. to 16 cts. for phosphor-bronze bearings.

The convention spent practically all of Thursday and Friday forenoon in discussing the revision of the rules and scant time was left for the consideration of the remaining reports. The convention fully realized this fact, so fully that as soon as the work on the Interchange Rules was finished a good deal of precious time was spent in discussing the advisability of extending the time of the convention and giving up the old precedent of holding sessions for only three days.

The report of the Committee on Cast Iron Wheels, published in our last issue, was read. The subject was referred back to the committee with instructions to investigate more fully the claims made for the contracting chill and determine their truth.

The report on steel-tired car wheels (see last issue) was read and the committee continued for another year. The report on "Standards and Limits for M. C. B. Couplers," also given in our last issue, was read. The gages were ordered submitted to letter ballot for adoption as standards. The limits for the size of the shank of the coupler were adopted provisionally for one year and referred back to the committee for further investigation. The recommendation that a standard method of operating the locking devices be adopted was also referred back to the committee for further recommendation. The method of fastening the tail of the coupler was referred to a special committee to be appointed hereafter. The specifications reported were adopted for use during the year, and the recommendation that a laboratory test be made during the fall was referred to the Executive Committee.

The report on "Steam Heating and Ventilation" (which contained nothing whatever about ventilation, by the way) was presented, and it was at first proposed to submit the standards to adoption by letter ballot. The fact that nobody had used the one modest standard subject which was adopted last year, was rather a damper on this, and it was finally voted to adopt the standards provisionally for one year.

The most important committee report which has been before the Association for a long time, that on "Standards of the Association," was presented by Mr. R. H. Soule. We discussed this report editorially last week. Unfortunately the hour was so late that discussion was not to be had and the report was referred to the Executive Committee with instructions to appoint committees to take up the subjects of the report and recommend action by the next convention. Therefore it is needless for us to review the report further this year, as we had intended to do.

The report of the Committee on Standard Centerplates and Stake-pockets, published last week, was not presented to the convention, as it was found that some of the features of the devices presented by the committee for adoption were covered by patents.

The last report presented was that of the Committee on Standard Tests of Air Brakes, the substance of which we have already published. In addition, Mr. G. W. Rhodes, chairman of the committee, presented the results of some tests recently made, with the object of establishing a standard to which triple valves should conform. These notable tests we abstract and discuss elsewhere.

The discussion occupied a good share of the first session on Monday, and about 2½ hours on Tuesday morning, and a great amount of important information was elicited, which we have reported elsewhere. At the close of this discussion on Tuesday, the report of the Committee on the Present Status of the Car Coupling Question was presented by Mr. M. N. Forney. The report recommended merely an expression of approval of the action of the M. C. B. Association, but after some discussion it was concluded best not to interfere in any way until the M. C. B. Association has completed its work now in progress on coupler standards.

This concluded the technical work of the convention. The matter of subjects for next year's meeting was left in the hands of the Executive Committee. It was voted to change the by-laws to make the time of holding the annual convention the second Tuesday in June (instead of Wednesday), and the hours of each session 9 a. m. to 1:30 p. m. The following officers were elected in accordance with the report of the Nominating Committee: President, E. W. Grieves, B. & O.; Vice-Presidents, F. D. Casanave, Penna.; J. S. Lentz, Lehigh Valley; T. A. Bissell, Wagner Car Co.; Treasurer, J. W. Demarest, Northern Central; Executive Committee, J. T. Chamberlain, G. W. Rhodes, Pulaski Leeds, J. C. Barber. After some discussion over the place of meeting for the next convention, in which a general sentiment in favor of some place in the vicinity of Chicago was evident, the convention adjourned.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—The 25th annual convention began at Congress Hall, Saratoga Springs, N. Y., on June 20. President John Mackenzie in his opening address congratulated the members on the phenomenal growth of the Association during the past five years. At the meeting in St. Paul in 1887, the Association numbered 270 members. Since that time there has been an increase of 241, making a total membership at the present time of 511. There has been steady improvement in the character of the reports submitted by the Association's committees and some of those of the present

year are fitted to rank with papers presented before any engineering society.

At the calling of the roll 91 members responded to their names. The Secretary's report showed a total increase in membership of 53, the membership of each class one year ago and now being as follows:

	Active.	Associate.	Honorary.	Total.
June, 1891	420	14	14	458
June, 1892	475	16	20	511

The Association has lost one honorary and seven active members during the past year, Messrs. Ross Kells, W. F. Turreff, Wm. Wilson, Edward Nichols, Wm. Smith, Jos. Bradt, W. F. Bradley and Jas. Sedgley.

In accordance with the action taken at the last convention the Association has been legally incorporated under the laws of the State of New York. The committee on the Boston fund has purchased four scholarships in the Stevens Institute of Technology and turned over the Boston fund, amounting to $8,000, to that institution. But one of these scholarships (which are for the benefit of sons of members of the Association) has thus far been taken advantage of, and arrangements have been made by which the scholarships not used in the Institute will be available for those desiring to enter the Stevens preparatory school. Several members, however, have sons who will endeavor to pass the entrance examinations for admission to the Institute this fall.

The Treasurer's report was as follows:

Total receipts (including cash on hand one year ago)	$4,084.26
Total expenditures	2,597.83
Cash on hand	$1,486.43

Annual dues of $5.00 per member were assessed and an Auditing Committee was elected. A resolution was introduced by Mr. J. H. Setchel and carried unanimously, affirming the clause of the constitution which states that those in charge of car building work above the rank of general foreman are eligible to membership. A second resolution was carried without opposition to the effect that all questions pertaining to the design, construction and repair of rolling stock, whether locomotives or cars, are proper questions for discussion by the Association.

The first of the committee reports on technical subjects called up was that on exhaust pipes, nozzles and steam passages. Members of the committee stated that they had not been able to prepare any report in addition to that presented last year. Some extensive tests were necessary to settle some of the questions before the committee and they had been unable to carry them out. On motion, the committee was continued.

The Committee on a Standard Method of Conducting Locomotive Tests also had no report. Mr. Lauder, the chairman, said that a similar committee had been appointed by the American Society of Mechanical Engineers (its preliminary report was given in a recent issue of Engineering News) and had proposed that joint action be taken by the two committees. The Master Mechanics' committee, however, whose bump of caution seems to have been quite a protuberance, refused to attempt joint action with the Mechanical Engineers' committee until specially authorized to do so by the Association. The special authority was speedily granted and the committee was continued in office.

Next came the great report of this convention, that of the Committee on Compound Locomotives, who, as our readers know, have been conducting an extensive series of tests to determine the relative economy of the simple and the compound locomotive. The subject is of such importance that we reprint the substance of the report and of the very lively discussion which followed it, on another page. The committee was continued for another year, as it proposes to continue the tests and cover a much wider field than in the present report.

Evidently the subject of compound locomotives is one of great interest to the members of the Association. The speakers in the animated discussion on the subject were listened to with close attention and points made either for or against the compound were warmly applauded.

Exhibits at the Convention.

The annual museum of mechanical progress, which is one of the main features of the M. C. B. and M. M. Association conventions, was on hand this year as heretofore. More than 120 firms or individuals dealing in railway supplies had exhibits displayed on the verandahs of Congress Hall. The most numerous class of exhibits, it is needless to say, were the car-couplers. The list of couplers conforming to the M. C. B. lines included the Hinson, Van Dorston, Standard, Thurmond, Smillie, Drexel, Perfected, Buckeye, Empire, Trojan, Columbian, Williams and American, a total of 13. There were also about a dozen hopeful exhibitors with various other types of car-couplers, some of them quaintly absurd. Certainly the most striking thing among the coupler exhibits, in more senses than one, was that made by the Standard Co. On the lawn back of Congress Hall a full size apparatus for making drop tests of couplers was set up, with a 1,640 lb. hammer, and the Standard couplers were subjected to a drop test for the edification of the members. The new Standard coupler has a knuckle of forged steel. Two at least of the other M. C. B. drawbars exhibited had the bar itself made of cast steel. The Standard Co. challenged the other couplers represented to subject their product to the same test, but none chose to do so, whether from fear of the consequences or from unwillingness to help advertise a rival exhibit, it is impossible to say. The Standard Co. deserved and received great credit for its enterprise, however.

It is a significant fact, and a most hopeful one as well, that the manufacturers of couplers who have attained a standing, and even the new ones which are coming into the field, seem to fully appreciate that strength and durability is what is demanded, and not cheapness in itself or new and novel details. In fact, the proposed adoption of a standard method of unlocking by the Association will tend to eliminate still more completely the present differences in construction, and make still more clear the fact that the best car coupling, like the best car axle, is to be the one made of the best materials and by the best processes. The car-coupling question is no longer one of patents, but one of manufacture.

Other exhibits of interest in connection with draw gear were the Van Dorston and the Thurmond carrier irons, each of which allows the coupler considerable play for passing sharp curves. The Butler draw-bar attachments were also shown full size. All these exhibits excited favorable comment, and deserved it.

In brakes, the exhibits were few, although representatives of the principal companies were present. One or two backwoods exhibitors were also on hand with remarkable models of their devices. An automatic brake-slack adjuster was shown by the Hinckley Brake Co., of Trenton, N. J. In metal brake-beams the Schoen pressed steel, the Universal, the National Hollow, the Marden and the Kewanee were exhibited. The National Hollow at present seems to lead all competitors in patronage. The Schoen Co. had a fine exhibit, including also pressed steel axle boxes, stake pockets, center plates and draft rigging. One center plate shown had been tested with a load of 270,000 lbs. The Northwestern Equipment Co., the makers of the Kewanee brake-beam, also showed a handy gage for testing worn and bent M. C. B. coupler knuckles. Another very important exhibit in pressed steel was two full size Fox pressed steel trucks, whose combined simplicity, lightness and strength was very notable. Pressed steel box-lids were shown by the A. French Spring Co. and the Drexel Supply Co. The former firm also showed a locomotive spring with V-shaped band.

The most interesting exhibit in springs, however, was that of Robert B. Johnston & Co., who showed car and locomotive springs with concave leaves. The concavity keeps the leaves in line and makes the tensile strain greatest along the center line of the leaf, with the result that a spring of a given deflection and strength weighs only about three-fourths as much as a flat leaf spring. Springs of this type are being placed under cars and locomotives by several prominent railways. While artificially produced stiffness is in the abstract a defect in steel springs, the slight concavity would seem to be a decided improvement.

Other exhibitors of springs were the E. L. Bushnell Spring Co., of Poughkeepsie, and the Vose & Cliff Spring Co., of New York City. The New York Car Wheel Co. made an excellent exhibit of ground and balanced cast iron wheels. Steel wheels were shown by Coolbaugh & Pomeroy, the American Steel Wheel Co. and the Cushioned Car Wheel Co., of Indianapolis. The Standard Steel Works, of Philadelphia, showed the process of manufacture of wrought-iron wheel centers by the Vauclain process, which is one of striking merit, if wrought wheels are to be used at all. Other noteworthy exhibits in iron and steel were those of the Ewald Iron Co., of St. Louis, the Oliver Iron & Steel Co., of Pittsburg, and Coolbaugh & Pomeroy, representing the Cambria Iron Co. The first named firm showed stay bolt iron of remarkable toughness, specimens being twisted cold into a corkscrew, and the last named firm showed axles treated by the Coffin toughening process, which raises the elastic limit as much as 20 to 30% without increasing materially the tensile strength or decreasing elongation.

Several new anti-friction side and center bearings were shown, including the Jewett center and side bearings, which are in use on the Boston & Albany, the Mullen roller side bearings, a very recent invention, in use on a Western road, and King's yielding side bearings, made by the Vose & Cliff Mfg. Co. An anti-friction journal bearing of great ingenuity, employing tubular steel rollers, was exhibited by the Meneely Bearing Co., of Troy, and attracted much attention. We shall shortly illustrate it. For street railway work, especially, it would seem to have much in its favor. Close by it was the exhibit of the Simonds Rolling Machine Co., of Fitchburg, which included steel balls for bearings and rolled screws, pins and bolts, of excellent appearance. It is evidence of the great extent to which anti-friction bearings are now used in machinery that the Simonds Co. is now filling orders for steel balls at the rate of 18,000,000 per annum.

Car doors were numerous, as always, and several new ones were shown. Two novelties in journal box dust guards were noticed, one a double guard made of wood fiber with spring between to take up wear, the other a guard lined with rawhide strips. Car roofs were shown by the Philip Carey Mfg. Co., of Cincinnati, F. W. Bird & Son, of East Walpole, Mass., and C. B. Hutchins & Son, of Detroit.

It is evidence of the increasing interest in car ventilation that three different appliances were exhibited, the Pancoast, the Rogers and the Palmer. Steam-heating exhibits were confined chiefly to the established companies. The Consolidated Co. had their model train in a conspicuous place, headed by a perfect model of a locomotive to about 1-12 scale, and thus showed very perfectly the details of their different systems. The Gold, the Morton (which stores heat in terra cotta tubes over the steam pipes), and the Erie, were the other companies exhibiting. Among the other exhibits relating to passenger cars were the King window holder and "anti-rattler," the Burrowes car shade, the Putnam & Stiles extension car step, the Wood safety gate, Bower's veneering, "Pantasote" imitation leather goods for interior finish, car plushes by the Massachusetts Mohair Plush Co., various styles of car seats, etc. One of the most attractive exhibits in passenger car appliances was that made by the Safety Car Heating & Lighting Co. Two of the latest style lamps were shown, one burning ordinary city gas, the other Pintsch oil gas. Both were burned at the same pressure and at the same rate and the contrast between them was much commented on. The company was generally conceded to have distanced all other railway supply firms in its choice of a souvenir for distribution at the convention, the souvenir being a very artistically designed spoon of sterling silver.

The tools shown among the exhibits included some of great interest. The "universal trimmer" shown by the American Machinery Co., of Detroit, won universal approval. It was, and is, a particularly meritorious and simple tool. A turret lathe by the Jones & Gamson Machine Co., and a universal boring machine for drilling holes of any shape by the Pratt & Whitney Co. were the principal other exhibits in machine tools. In smaller tools, a novel chain pipe wrench and ratchet drills were shown by Greene, Tweed & Co., of New York, and the Ide Wrench Co., of Troy, a crankpin testing gage by M. C. Hammett, of Troy, and jacks by A. O. Norton and the Chapman Jack Co.

Very creditable exhibits of well known specialties were made by the Ross Valve Co., the Crosby Steam Gage & Valve Co., the Mason Regulator Co., the Detroit Lubricator Co., the Nathan Mfg. Co., Fairbanks & Co., Jenkins Bros., Gilmour Mfg. Co., H. W. Johns Co., and the Peerless Rubber Mfg. Co.

Among exhibits of special interest to locomotive men were the Boyer speed recorder, Damascus bronze bearings, the Russell snow plow, the Fowler ash pan, the Leach sand feeder (which has strong points), the Pennell water purifier, the Vacuum cooling compound and the Tilden and the Norwood car replacers.

COMING TECHNICAL MEETINGS.

AMERICAN INSTITUTE OF MINING ENGINEERS.
June 28. Bluff Point, N. Y. Secy., R. W. Raymond, New York.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
July 1. Secy., E. K. Smoot, 308 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
July 1. Secy., O. von Geldern, 819 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
July 2. Secy., F. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
July 2. Union Station, St. Paul.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
July 4, 5. At Richmond. Secy., J. B. Schick, Roanoke, Va.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
July 7. Secy., T. G. Pihlfeldt, 113 Adams St.
WISCONSIN POLYTECHNIC SOCIETY.
July 11. Loan & Trust Bldg., Milwaukee. Secy., M. G. Shinke.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
July 11. Secy., C. L. Annan.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
July 14. Secy., Edward Mead, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTHWEST.
July 14. Secy., O. H. Landreth, Nashville, Tenn.
MONTANA SOCIETY OF CIVIL ENGINEERS.
July 16. Secy., F. D. Jones, Helena.
ENGINEERS' CLUB OF CINCINNATI.
July 21. Secy., J. F. Wilson.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Aug. 18. At Atlanta, Ga. Secy., F. A. Charlot, Macon, Ga.
ENGINEERS' CLUB OF PHILADELPHIA.
Sept. 3. 1122 Girard St. Secy., L. F. Rondinella.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 7. Secy., F. Collingwood, 127 East 23d St., New York.
WESTERN RAILWAY CLUB.
Sept. 20. Rookery Building, Chicago. Secy., W. H. Marshall.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Sept. 20. Secy., R. N. Clark, Pittsburg, Pa.
ENGINEERS' CLUB OF ST. LOUIS.
Sept. 21. Secy., Arthur Thacher, Odd Fellows' Building.
CENTRAL RAILWAY CLUB OF BUFFALO.
Sept 28. Secy., Jas. Macbeth.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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ADVERTISING RATES, 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The pressure of convention matter upon our columns is so great that we have been obliged to postpone for this issue and that of last week the continuation of our articles on the engineering schools of the United States, as well as various other articles which would otherwise be published. Hereafter we shall hope to be able to continue the series to completion without interruption. June is the month of conventions, and between water-works, master car builders, master mechanics, civil engineers, mining engineers, mechanical engineers, and what not, we are always glad when June is past.

A correspondent who ought to be well informed, but who seems to be influenced more by his emotions than his judgment, sends us a communication in defense of what he declares to be the "scientific" use of the word "strain," which we have impeached. He incorrectly declares in opening that we proposed to use the word "strain" in the sense of internal force, which we did not. What we did object to, and declare to be unwarranted and absurd, was the attempt to make the word "strain" mean distortion or stretch, instead of the force tending to cause such stretch or distortion. Why we think this is, of course, not explainable, if not self-evident. Why did Adam call a toad a toad? "It looks like a toad, and it hops like a toad, and let's call it a toad." In the inherited consciousness of the race the word t-o-a-d has acquired a certain unchangeable meaning, which we use to think with, and which this old conundrum neatly plays upon. We may disregard the word wholly, and teach a man to think of a toad as a "Bufonida vulgaris," but we cannot successfully misuse and tamper with the word by "letting" it mean an artichoke. We cannot successfully attempt to make shovel mean a shoveler. Neither can we successfully attempt to make "strain" mean the effect of a strain.

This is our position; and yet on this very point of inherited usage our correspondent takes issue with us. He declares:

> The "instinctive use of words" is in direct accord with the use of strain for displacement. For instance:
> (1) The rope was strained two inches.
> (2) The rope was strained two tons.
> Now (1) is at once recognized as the common use of strained; (2) is not. To be so, (2) should read, "The rope was strained by two tons." The "instinctive use of words" is dead against your position, and in favor of the scientific use. Again, "stress and strain" is a common expression, and every one using the expression has in mind "force" and "stretch." "The stress and strain in a rope" is perfectly clear, even to a layman.

What can be said in answer to such a position as this? Nothing except what Festus said to Paul, "Much learning hath made thee mad," unless little learning has made us so. Discussion is impossible when a premise in the nature of an axiom is not admitted. We do not say that the meaning of sentence (1) above might not be guessed at, but only that to native English-speaking ears the words "two inches" alone make the intended meaning of the word "strain" intelligible. The following sentences seem to us to embody all the non-figurative uses of the word "strain" which are warranted by good and general usage:

> If a non-elastic body be subjected to too great a strain, etc.
> Under the great strain (or force) of the waves the hawser parted.
> The strains by which a railway bridge is most severely tried are not static, but dynamic.
> A narrow shoe is so strained by the foot that it must necessarily either stretch or tear.

In all these examples "strain" is employed in the sense of a distorting force, and not in the sense of the distortion which results from the force. The only example to the contrary in the "Century Dictionary" is Rankine's sentence attempting the innovation in dispute. This was one of Rankine's errors, and not the only one. We shall shortly have occasion to point out another, both theoretical and practical, in his treatment of the subject of pile-driving. Rankine was a very great man, but he was only human, and the attempt to make a god of him by accepting as gospel everything he said or proposed is a trifle absurd. In this case he did knowledge an ill turn.

As for the compound expression "stress and strain" which our correspondent appeals, it is a mere pleonasm, used to give more emphasis by coupling two words of the same sense but different sound together, as we "acknowledge (and confess) our manifold sins (and wickedness)." Stress and strain are in theory and practice very nearly synonymous words when applied to physical forces. They popularly relate only to forms of force, and to those particular forms which tend to strain against and destroy each other. Force is the general term. A strain is one form of force, but in saying that centrifugal force "strains" a fly-wheel we do not mean that it either stretches or breaks it, but merely that it sets up a force tending to break it.

This will be too clear for words to most of our readers, but they must remember that we have the professors of engineering almost as one man against us. We renew our advice to the latter to quit coining new names for old things, and to confine their efforts to using old words more clearly if they find that "young minds" do not easily follow them.

RAILWAY CONSTRUCTION IN THE SOUTHERN STATES.

New railway construction in the States south of the Ohio and east of the Mississippi rivers shows a heavy decrease from the activity of the past few years. According to the map and statistics published with this issue the total mileage of all classes of work under way is 47.5% less than it was one year ago. The mileage of the new line in the various stages of progress in the nine States wholly or partly included on the map is shown in Table 1.

Table 1.

Table Showing by States the Mileage of Track Laid in 1891 and to Date in 1892, and the Mileage of New Line in Process of Construction and Survey, and Projected on June 23, 1892.

States.	Track laid. In year 1891.	Track laid. To date in 1892.	In process of construction.	Surveyed or under survey.	Projects of some prom ise.
Va.	182.2	...	97	446	175
N. C.	100	38	111.	457	377
S. C.	219.2	...	28.	189	470
Ga.	230	41	49.	883	373
Fla.	77.7	47	74.	329	407
Ala.	164.	6	289.	1,189	114
Miss.	...	...	...	258	...
Tenn.	147.5	...	132	324	815
Ky.	43	6	41	322	24
	1,172.6	138	821	4,407	2,755

Comparing these totals with those published in connection with the immediately preceding map of this section, we have the following results at the dates named:

	Track laid. Year previous.	Portion of year to date.	Under construct'n.	Under surv'y.	Projected.
June 13, 1891.....	1,952	517	2,248	5,817	6,025
June 23, 1892.....	1,172	138	821	4,407	2,755
Dec., 1892.....	780	379	1,424	3,270	3,270
Dec. per cent....	39.9	73.4	63.3	24.3	54.3

It will be seen that while decrease is large in all classes of work it is especially large in the mileage of lines in process of construction and track laid this year. Moreover, an examination of the detailed list will show that active work is in progress upon only a small proportion of this 821 miles. The mileage under survey shows the least falling off from last year's figures. It should be stated, however, that the decrease in the mileage both of the lines projected and under survey is not entirely due to the increase in the inception and organization of new enterprises. A considerable number of long lines which seemed to have sufficient vitality a year ago to warrant their inclusion on our map have made no progress since, and are excluded from our present figures. In order to permit of a more detailed comparison of the work in progress we show in Table 2 the mileage under construction and survey in each State at the dates of June 13, 1891, and June 23, 1892.

Table 2.

Table Showing Comparative Mileage of Railway Line Under Construction and Under Survey in the Southern States on June 13, 1891, and June 23, 1892.

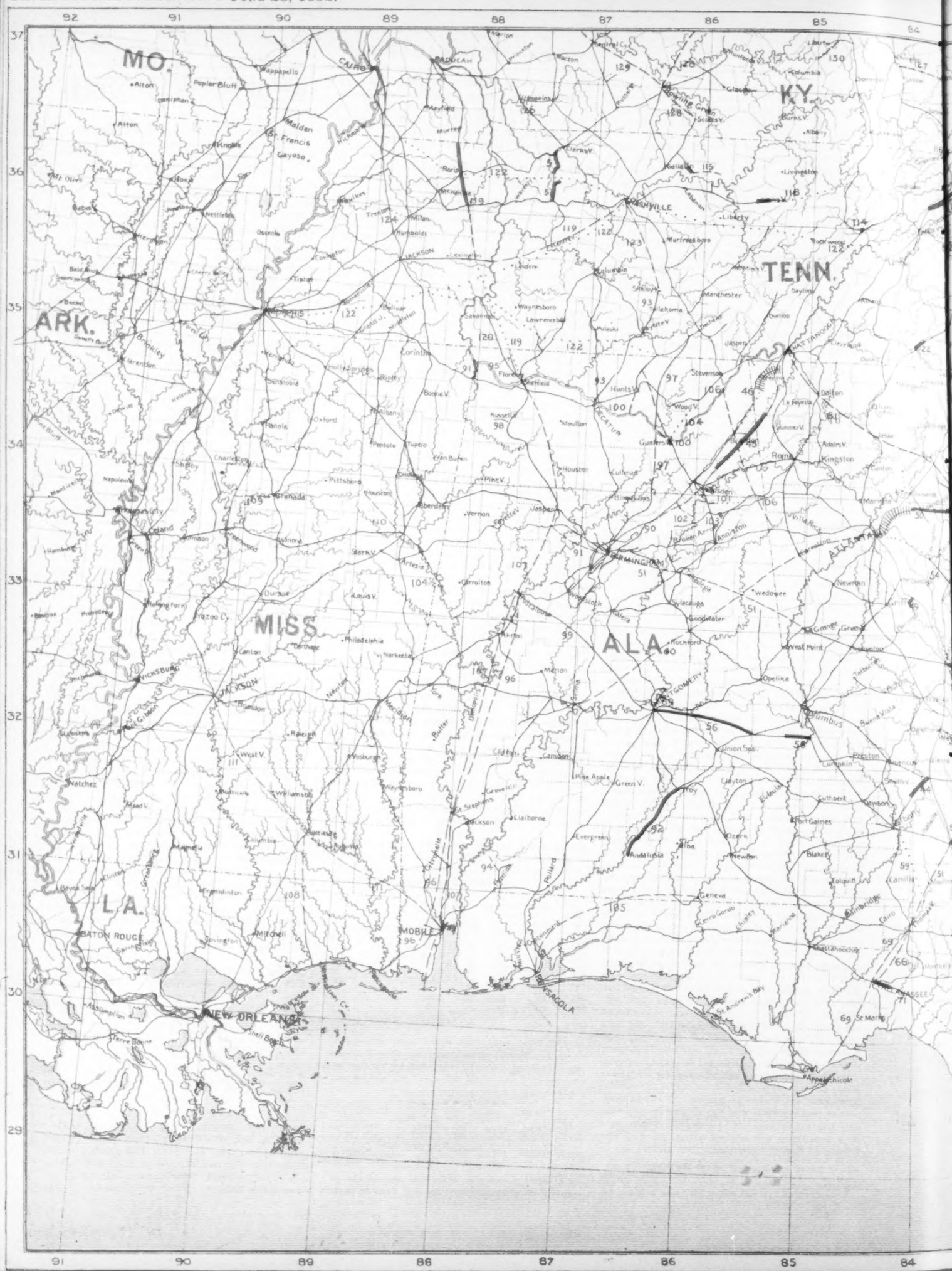
States.	In process of constr. 1891.	In process of constr. 1892.	Inc. or dec. p. c.	Sur. or under sur. 1891.	Sur. or under sur. 1892.	Inc. or dec. p. c.
Va.	200	97	—51.6	393	446	+13.5
N. C.	354	111	—68.7	659	457	—30.7
S. C.	478	28	—94.2	406	189	—53.4
Ga.	509	49	—90.4	885	893	+9.04
Fla.	190	74	—61.1	409	329	—19.5
Ala.	211	289	+36.9	1,500	1,189	—20.7
Miss.	51	...	—100.	491	258	—47.4
Tenn.	222	132	—40.6	554	324	—41.6
Ky.	33	41	—24.3	520	322	—38.8
Total	2,248	821	—63.3	5,817	4,407	—24.3

This table needs no discussion. It shows that but one State, viz., Alabama, has a greater mileage in process of construction than it did last year, and that but two States, viz., Virginia and Georgia, have a greater mileage under survey. On the other hand, all the other States show decreases in the line under construction and under survey of from 20% to 100%. These figures bear out the conclusions reached in connection with our map showing the prospects of new construction during the year (Engineering News, March 5, 1892), when we stated that probably less track would be laid in the South in 1892 than for several years previous. The reasons for this conclusion were given at that time, and the conditions have not been materially changed in the three months which have passed since.

With the possible exception of the Pacific States, no other section of the country shows the effects of the business depression of the past 18 months as reflected in its mileage of new railway construction so much as in the South. This is due to several things: (1) A very large proportion of the new construction which has made the Southern States the center of railway activity for the last five years was being carried on by young and consequently financially weak companies, so that as soon as any extra demands were made on their finances by the hard times they were unable to meet them, and many of them went into the hands of receivers and nearly all were compelled to suspend wholly or partly any steps toward further construction. (a) (2) Many of the projected lines were in a more or less sparsely settled and undeveloped country where there was little fear of competing lines being built and where the local traffic would have been small for several years. Thus the demand for their construction not being immediate, work was suspended until a more favorable opportunity. (3) The South more than any other section of the country depends upon outside capital, from the Eastern and Middle States and foreign countries, for its new railway construction, and, as is well known, capital has been very conservative since the troubles in the fall of 1890. In addition a feeling of caution and uncertainty has been inspired by the financial troubles of the Richmond & West Point Terminal Co., which controls a large percentage of the railway mileage of the South, and by the agitation for the free coinage of silver.

From the foregoing it will be seen that the conditions at present tending to reduce the amount of railway construction are in a large measure temporary. An examination of the detailed list and map will show the general location and progress of work on the various lines under way. It will be noticed

(a) A rough count shows 11 companies having a mileage of 1,050 miles completed and 1,100 miles surveyed and in process of construction, which have gone into the hands of receivers within the last 18 months.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BIRMINGHAM
MONTGOMERY
MOBILE
PENSACOLA
NEW ORLEANS
VICKSBURG
JACKSON
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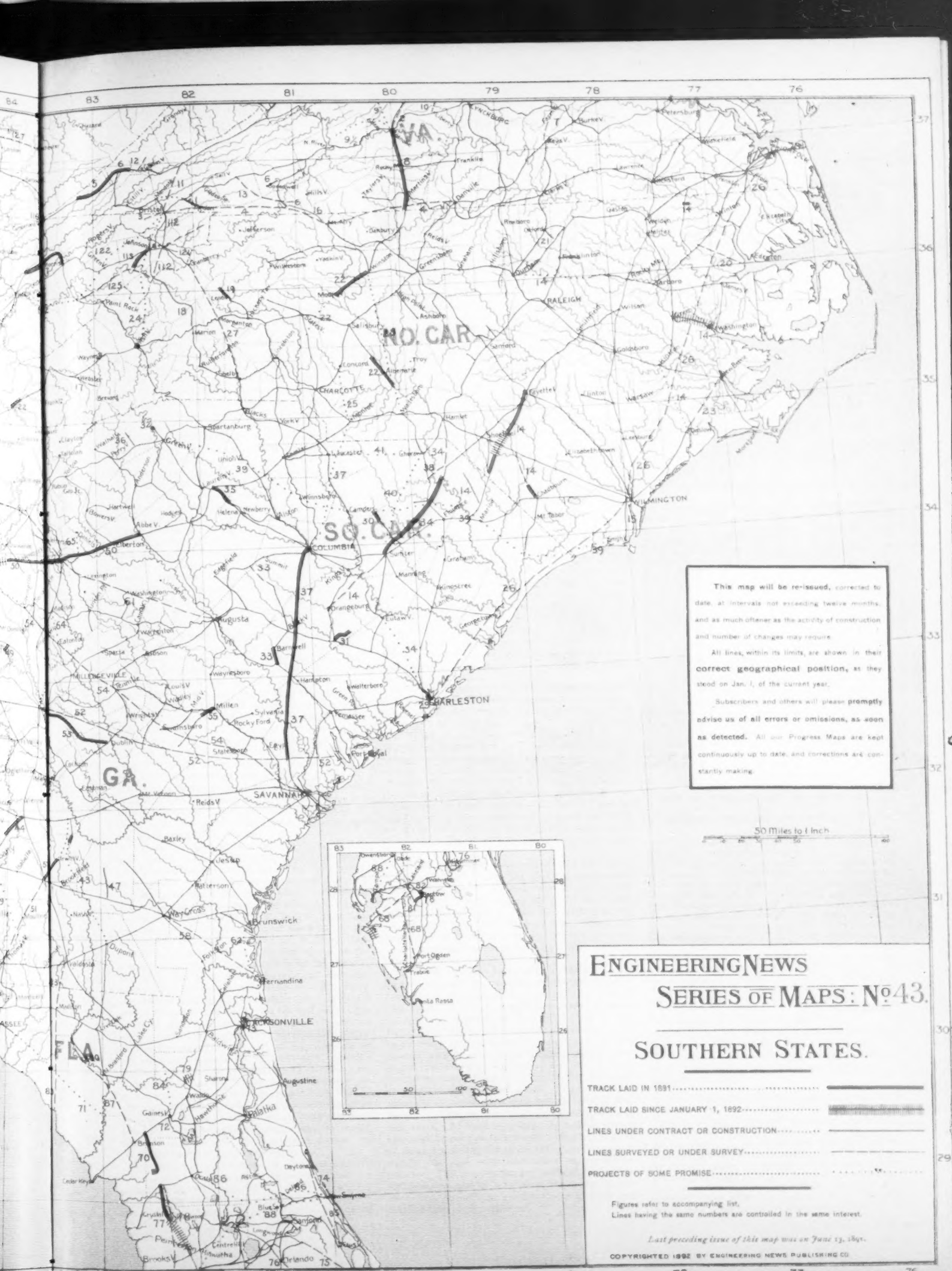

VA
NO. CAR.
S.C.
GA.
FLA.
RALEIGH
CHARLOTTE
COLUMBIA
CHARLESTON
WILMINGTON
SAVANNAH
JACKSONVILLE
Augusta
Macon
Columbus
Atlanta
Chattanooga
Knoxville
Asheville
Greenville
Spartanburg
Florence
Fayetteville
Goldsboro
Wilson
Rocky Mt.
Weldon
Petersburg
Richmond
Lynchburg
Danville
Roanoke
Norfolk
Portsmouth
Newport News
Suffolk
Elizabeth City
Washington
New Bern
Kinston
Greensboro
Salisbury
Concord
Asheville
Hickory
Statesboro
Waycross
Brunswick
Fernandina
St. Augustine
Palatka
Gainesville
Ocala
Orlando
Sanford
Daytona
Tampa
Port Tampa
Bartow
Arcadia
Fort Ogden
Punta Rassa
Trilby
Wauchula
Sharon
Waldo
Hawthorne
Dupont
Baxley
Uvalda
Hazlehurst
Dublin
Millen
Sylvania
Rocky Ford
Swainsboro
Louisville
Wrightsville
Wayneboro
Millen
Milledgeville
Sparta
Eatonton
Washington
Lincolnton
Abbeville
Greenwood
Laurens
Clinton
Newberry
Winnsboro
Camden
Kingstree
Sumter
Manning
Orangeburg
Lake City
Florence
Marion
Mullins
Conway
Georgetown
Hartsville
Bamberg
Barnwell
Allendale
Hampton
Walterboro
Yemassee
Port Royal
Beaufort
Summerville
Charleston
Mt. Pleasant
Moncks Corner
Pineville
Lancaster
Chester
Rock Hill
Gaffney
Union
Whitmire
Clinton
Laurens
Greenville
Spartanburg
Shelby
Rutherfordton
Forest City
Marion
Morganton
Lenoir
Hickory
Newton
Statesville
Mooresville
Salisbury
Thomasville
High Point
Greensboro
Reidsville
Danville
Martinsville
Rocky Mt.
Franklin
Lynchburg
Farmville
Burkeville
Petersburg
Suffolk
Portsmouth
Norfolk
Virginia Beach
Elizabeth City
Edenton
Plymouth
Washington
New Bern
Morehead City
Beaufort
Jacksonville
Wilmington
Fayetteville
Dunn
Smithfield
Clayton
Raleigh
Durham
Oxford
Henderson
Warrenton
Roanoke Rapids
Weldon
Scotland Neck
Tarboro
Greenville
Kinston
Goldsboro
Warsaw
Clinton
Elizabethtown
Whiteville
Lumberton
Red Springs
Maxton
Laurinburg
Hamlet
Wadesboro
Monroe
Albemarle
Concord
Kannapolis
Gastonia
Shelby
Lincolnton
Newton
Hickory
Taylorsville
Statesville
Mooresville
Salisbury
Thomasville
High Point
Asheboro
Ashboro
Troy
Star
Sanford
Apex
Cary
Raleigh
Zebulon
Wendell
Louisburg
Franklinton
Henderson
Oxford
Durham
Chapel Hill
Pittsboro
Siler City
Sanford
Lillington
Dunn
Benson
Smithfield
Selma
Four Oaks
Clayton
Garner
Fuquay Springs
Angier
Erwin
Dunn
Lillington
Buies Creek
Coats

that with one or two exceptions none of the older and larger companies have any active work in progress. Many of them, however, have extensions in view, which, while not far enough advanced to be included on the map, will probably be constructed as soon as conditions will permit. In general it may be said that the prospects are favorable for more work next year than for this, but it is doubtful if the increase in new railway for the next year or two will equal that of the two years passed.

THE M. C. B. AND M. M. CONVENTIONS.

The conventions of the railway mechanical associations which have been held at Saratoga last week and this have been on the whole very successful. To the railways the Master Car Builders' meeting is the more important of the two, since that organization is at present the only means which the railways possess of securing joint action on mechanical matters. The importance of joint or uniform action in all matters pertaining to freight car construction is becoming every year more evident. The list of standards at present in force is pretty generally believed to fall short of filling the needs of the railways, and there is more or less talk which may some time amount to something of the need for one or more standard cars, or at least for a standard truck. Unfortunately, the importance of the work done and which might be done by the Master Car Builders' Association is generally underestimated by the higher officials of railways. The idea still holds, and is not wholly incorrect, that the car builders' meeting, like the meetings of the roadmasters, train dispatchers, telegraph superintendents or other classes of railway officials, is a sort of holiday in which the members combine a certain amount of discussion on subjects connected with their work with a good deal of recreation. Consequently some general managers will look askance at the proposition to increase the time of the M. C. B. convention to four days, or more, if necessary to transact the business, as was proposed in this year's convention; but more will look on it with favor, including all the better informed men, as it would hardly be possible to exaggerate the value of the work which the M. C. B. Association has done in recent years, largely by a few very able men, it is true, but none the less effectively.

It is doubtless true that if all the business of the convention were taken up in a proper manner, discussed rapidly and concisely, and disposed of by intelligent vote, a great deal more business could be done in a much shorter time than is now required. But, after all, the same thing might be said of any deliberative body, from Congress down. In fact, compared with the House of Representatives or any of our State Legislatures, the Master Car Builders' Association is a model of good order and strict and intelligent attention to business.

It seems the part of wisdom, therefore, to take such time as is necessary for the Master Car Builders' conventions. This year one of the most important reports ever before the association, that on standards, on which we have already commented, was presented near the close of the last day's session and was not discussed at all. In fact, so much time was taken up in the discussion of the rules for the interchange of freight cars that practically no time was left for the proper consideration of any of the committee reports. If the members of the association will "live up to their opportunities," they can accomplish even greater things for the railways of the country than they have already done. It should not be forgotten that it is to this association that the railways of the country are indebted for the position with regard to the use of safety appliances in which they now stand. Had the work of the association in the adoption of a standard type of automatic coupler not been done, the present widespread agitation concerning the deaths and injuries to railway employees would have found the railway companies in the humiliating position of having done practically nothing toward the saving of the lives and limbs sacrificed annually to the link-and-pin coupler, and we should today have made little or no progress toward the use of automatic freight train brakes.

We noted last week the results of the committee's investigations concerning the extent to which the standards had been adopted. In view of the facts thus brought to light the committee recommended that, besides abandoning certain standards which have become obsolete, the remaining standards should be amended where necessary, and divided into two classes, "standards" and "recommended practice," the term "standard" to be confined to those details which promote quick and cheap repairs and free interchange of cars, such as wheels, axles, journal boxes, draw and brake gear, and screw threads. The remainder of the present standards, such as cast iron wheel specifications and guarantee, which, however desirable and important, do not affect directly car interchange, they advised should be termed merely "recommended practice."

The committee further advised the revision of the present standards for light axles, height of drawbars, passenger truck pedestals, protection of trainmen, platform safety chains, and marking cars. The report richly deserved very careful discussion, but as that could not be it was wisely referred to the Executive Committee without attempt at discussion, with instructions to appoint certain recommended committees and otherwise put the recommendations in proper shape for the association to act on at its next convention.

It is interesting to note that nearly every action of importance taken at the recent convention referred to couplers. The most important, probably, is that providing for the preparation of a standard method of unlocking, and the adoption of standard methods of testing. In the interchange rules, however, the association condemned couplers with knuckles of cast or malleable iron, and adopted new rules which will considerably facilitate repairs on couplers of all types.

The Master Mechanics' meeting has been principally a meeting for the consideration of compound locomotives, a consummation which two or three years ago no one would have believed possible.

Mr. Gibbs, the chairman of the association's committee on the subject, has carried out a comparative test with most painstaking care and thoroughness, the results of which we have duly recorded. The facts determined by this test have some bearing on the design of compound locomotives; but to be of value in determining the relative economy of simple and compound locomotives they are from 12 to 24 months behind time.

The facts are that with over 300 compound locomotives now in service in this country there is a very large amount of information available as to the fuel which can be saved by the use of the compound. The record of the monthly performance sheets of five or ten engines and of a half dozen different roads is better evidence of fuel economy than the most careful series of tests on a single locomotive, although the latter will determine other facts which the former will not. Mr. Vauclain undoubtedly hit the nail on the head when he said that the way to test compound locomotives at the present time is to put 5, 10, 15 or 20 into service, keep regular performance sheets as of all engines, and watch results.

The question is often asked, what is the percentage of economy of the compound over the simple locomotive. The answer is, that depends—on a very great number of variables, so many that in the discussion in the convention economies varying all the way from —7% to 44.9% were reported. There is a large body of evidence, however, showing an average economy in regular work of 10 to 25%; perhaps it is oftener stated 15 to 30%.

With this evidence at hand it is difficult to see where a railway runs any great risk in investing in a fair number of compound locomotives. A saving in fuel, greater or less, is practically certain. Suppose for the sake of argument that it is no more than 10%. Even this saving, with coal at average prices, would cover quite a heavy increase in the repairs account and interest. An average engine burns $2,500 to $3,000 worth of fuel yearly, 10% of which is $250 to $300. The cost of compounding will rarely exceed $750, 6% on which is $45. The total cost of repairs is not much more than half the cost of fuel, usually, and the increase in this item must surely be very small. At the worst, then, the railway cannot lose much by such an investment, while the prospects of making a saving are much better proved than is usually the case with innovations on established practice. The greatest danger, perhaps, is that the additional complexity may cause the engine to lose more time, but neither fact nor theory tends to give much weight to this objection.

It may be said as a valid objection to extensive equipment with compound locomotives that improvements are being constantly made in the compounds, and that it is best to wait until a greater state of perfection is reached. But if it is acknowledged that the compound is a better machine than the simple engine and will save money for its owner, why wait for the ultimate perfection of the compound, which is not likely to be reached for several generations at least? It certainly is to be expected that every progressive road will adopt proved improvements of proved merit. The compound locomotive is at that stage now; and those who have not heard of it should put it in service and see for themselves.

We could wish that the several engineering societies saw their way to attempting more work for the public good of the same general nature as that done by these associations of officials. There is similar work which needs doing, and the Mechanical Engineers have tried to do some of it, but the Civils have done very little. It would greatly add to the importance, usefulness and prominence of those societies to do somewhat more of it, though there are limits to wise and proper action of this kind, which the Western Society of Engineers has recently far exceeded.

LETTERS TO THE EDITOR.

THE HIGHEST RAILWAY POINT EAST OF THE MISSISSIPPI.

Sir: In your late issue Mr. Emile Low, in his article on the "Big Bull" tunnel, is mistaken when he states that "the highest elevation of any standard gage railway east of the Mississippi River is the altitude of 2,754 ft. at Tip Top, on the Clinch Valley Division of Norfork Western R. R. The West Virginia Central R. R. reaches the altitude of 3,132 ft. crossing Kent Ridge 1½ miles northwest of Davis City, Tucker Co., W. Va. The highest point on this road is at Fairfax Summit, where the altitude is over 3,200 ft. I have not the exact figures. Y.

Dunkirk, N. Y., June 14, 1892.

POWER AND ENERGY; CORRECTION.

Sir: In quoting a few remarks I made at the Philadelphia Engineers' Club, a few weeks ago, the Secretary of said club made a mistake in taking down the word power for energy. Your issue of June 16 contains (p. 602), under Society Proceedings, the following expression: "It requires more power to cut iron than steel of the same dimensions." It ought to read "energy" instead of power. The following "less power for both materials" is, however, correct. You will readily understand my desire to have such a statement corrected. Will you kindly note it?

I remain, yours very truly,

Henrik V. Loss.

Pencoyd Iron Works, Pencoyd, Pa., June 18, 1892.

EXPERIENCE WITH CEMENT JOINTS IN WATER PIPE.

Sir: In response to your request for information based on practical experience in the use of cement joints in water pipe, I beg to state that in 1880, while in charge of the Central Falls (R. I.), water-works, I encountered about 1,000 ft. of 6-in. pipe which had been previously laid for fire service, and only used when required for that duty, laid with cement joints. As the saving to the district would warrant the experiment, I recommended this pipe to be connected with the complete system then under construction, in order to test, by actual experiment, whether it could remain in service. The result was entirely satisfactory, not a leak being detected, and I presume it still remains in good condition. The pressure in this pipe is exceptionally high, according to my recollection over 100 lbs. to the sq. in. Yours truly,

C. H. M. Blake.

Guadalajara, Mexico, June 7, 1892.

(The above very practical information reaches us from a long distance off, but is none the less welcome. If anyone can give any further information on the same subject, pro or con, we shall be pleased to receive it.—Ed.)

A ROAD-MAKING EXHIBIT AT THE WORLD'S FAIR.

Sir: Permit me to call your attention to the inclosed "Open Letter." The movement throughout the country for better roads is one of the most significant and important events of the nineteenth century. It is a popular uprising against the bondage which is upon the people that are hampered by poor means of communication; it is a protest against the vicious system of false economy which causes a road tax to be indirectly placed upon every article of consumption; it is the re-

sult of the great national discontent with a tariff, all the more burdensome because of its insidious and needless character.

Good roads cheapen the cost of transportation by saving time, reducing the wear of draft animals and of vehicles, and thus lessen the cost of material to the producer and consumer. One of the saddest signs of the times in the older states is the tendency of population toward the cities and the abandonment of farms. The modern development of "slums," the wretched outcome of life in tenement houses, can be laid largely to the bad roads existing in the farming districts, which in certain seasons of the year prevent social intercourse, making country life cheerless, isolated and narrow. Churches and schools are neglected when roads are such as to make them difficult of access.

The opportunities presented by the World's Columbian Exposition of teaching the twenty millions of visitors what good roads are, and how to make and maintain them, should not be lost sight of. A comprehensive display of these things would advance the movement a hundred years and would hasten the coming in of a nobler civilization and a wider christianity.

It is hoped that every public-spirited citizen will feel the importance of this grand movement, and will be inspired to give impulse to it. If you publish this will you kindly send me a marked copy, as extracts from newspapers, indicative of public opinion, are desired for a memorial that is being prepared for presentation to Congress.

Congress is asked to appropriate from $5,000,000 to $8,000,000 for the Exposition. The national character of the Exposition is such that it is eminently fit that it should have national aid, but when that aid is extended, should it not be contingent upon there being suitable recognition of the importance of a comprehensive exhibit of road-making and maintenance?

Very truly yours, Albert A. Pope.

Boston, Mass., June 10, 1892.

(The accompanying "Open Letter to the People of the United States" urges that:

The World's Columbian Exposition will be attended by millions of our citizens, and no better opportunity has ever presented itself, or is likely to present itself, during the lifetime of anyone now living, to teach the great lesson of the need, the construction, and the maintenance of good roads. But under the present arrangement and classification of exhibits the opportunity will be wholly lost. Anyone interested in the subject and endeavoring to learn what he can as to the best methods and machinery to be used in the building of a highway, will probably consult the 120 page catalogue, a "Classification of the World's Columbian Exposition: Chicago, U. S. A., 1893: adopted by the World's Columbian Commission," and find Classified in Department A, Agricultural Building (Area, with annex, 13 acres), 7 classes of exhibits; in Department E, Mines and Mining (Area, 56 acres), 7 classes; in Department F, Machinery (Area, with annex, 15.8 acres), 1 class; in Department G, Transportation Building (Area, with annex, 14.4 acres), 4 classes; in Department L, Manufacturers and Liberal Arts (Area, 30.5 acres), 3 groups.

In other words, he finds that he must visit five enormous buildings having with their annexes an aggregate area of 79.3 acres. Some of these buildings are necessarily located at long distances from the others. These buildings and the pathways between them will be thronged with thousands of persons, and the great difficulty of even finding these several special exhibits is apparent to any one who has ever attended any of the great expositions."

Therefore Mr. Pope urges with much force that there should be a separate building for road-making exhibits. We sympathize with his aim, and if it be reasonably practicable we think it should be done, as there is, perhaps, no single class of exhibits which might be expected to produce such important practical effect if well managed and generally seen.—Ed.)

THE EFFECT OF HEAT ON PORTLAND CEMENT MORTAR.

Sir: I beg to inquire if you can refer me to any data on the influence of heat on Portland cements. We are about to put in a large culvert to convey the hot gases from reverberatory furnaces to a stock, and owing to the lowness of our ground will encounter water. If you can direct my research to the proper channel you will very greatly oblige. Yours very truly,

Wm. H. Pierce.

Ass. Man. Balt. Copper Smtg. & Roll. Co.

Baltimore, Ind., June 6, 1892.

(We are unable to find anything authoritative in technical literature to answer our correspondent's question. In a general way it is known that while cement mortar will stand a moderate degree of heat, such as found in a factory chimney for instance, wherever the heat is so great as to require the use of firebrick mortar of lime or cement is not suitable, as it would be calcined; that is, the compounds which give it its strength would be decomposed by the heat. Just where the line should be drawn, however, or at what temperature the use of cement mortar becomes inadvisable we are unable to say; and we trust some of our readers who have used cement under a considerable degree of heat, whether successfully or unsuccessfully, will report their experience for the benefit of our readers.—Ed.)

THE SAFE LOAD OF PILES.

Sir: If not too great a favor to ask, will you kindly give in your journal some information as to the safe loads on piles driven with Nasmyth or Cram steam pile driver? The case I have in mind is of a 2,800-lb. hammer, falling 24 ins., and striking 80 blows per minute. Is there any formula which will apply to such a case, and what would be a specification as to final penetration per blow, corresponding to ½ in. under a blow from a 2,700-lb. hammer falling 25 ft.?

I am, sir, very truly yours, A. Marston.

(We shall shortly discuss this whole subject at some length. The safe load for a pile driven under ordinary circumstances, with sufficient interval between the blows to enable the soil to settle back against the pile and "freeze to it," so to speak, is by the formula given and explained in our issue of Dec. 29, 1888, and which has come to be known as the Engineering News formula:

$$\text{Safe load} = \frac{2\ wh}{s+1} = \text{(ordinarily) 1-6 ultimate load.}$$

This is not only practically but theoretically as near to a complete expression of every element entering into the problem (other than air and frictional resistance to the descending hammer, and a very slight terminal bounce to each blow, which are insignificant and negligible) as it is possible to make. In it h = the fall in feet, s = the last set of pile in inches, and w = the weight of hammer in any unit, the safe load being given in the same unit. The set is assumed to have been reasonably uniform and the pile unbroomed during the last few blows, and the weight and fall of hammer is assumed to be such that it does effective work on the pile, and does not expend much energy in bouncing or brooming either the top or bottom of the pile. Whether it is doing the latter or not is a very important question which must rest with the judgment of the engineer or foreman, in most cases.

If blows are given in such quick succession that the resistance to penetration is no greater at the beginning of each set than at the end this formula will reduce to

$$\text{Safe load} = \frac{2\ wh}{s}$$

In a gunpowder pile driver, working well, this condition will substantially obtain, and in some soils it will obtain with 80 blows per minute, but not in others. In all cases of piles driven by blows the safe load will lie between these two extremes, if assumed at 1-6 of the ultimate. The same will be true of piles driven by a water-jet in sand, if it be known by experiment or otherwise what penetration will result from a few blows on the top of the pile after it has been sunk and the soil has settled around it. It will ordinarily be very small.

The safe load of a pile sinking ½ in. under a 25-ft. fall of a 2,700-lb. hammer is by this formula:

$$S = \frac{2{,}700 \times 25}{\frac{1}{2} \times 1} = 44{,}000 \text{ lbs.}$$

but in this case the ultimate bearing power is not six times as great, because a less load will be likely to crush the pile.

Few subjects have been so needlessly muddled by attempted mathematical hair-splitting as this of pile-driving, as will shortly be shown in these columns.—Ed.)

THE LAYING OUT OF KITE-SHAPED RACE TRACKS.

By D. H. Davison.

The way to lay out kite-shaped and ordinary race tracks was described in Engineering News, Oct. 11, 1890. Below are given some formulas which will be useful to anyone called upon to make an actual survey of one of the former type.

Before going on the ground to lay out the track, in order to do the work accurately and expeditiously, all of the following terms should be determined ready for use:

P, angle formed by intersection of center line with extended track, being also angle of radius and chord at their intersection at the end of arc.

r, radius of circle for judge's stand, plus three feet, from center line to track.

R, radius of arc.

A, half the length of track in arc.

T, straight track from arc, extended past wire to intersection of center line.

t, the part of T between wire and intersection with center line.

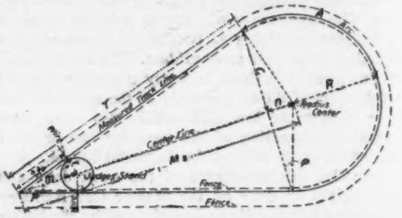
M, middle line from radius center to intersection of extended straight tracks.

m, the part of M from wire at center of stand to intersection with straight tracks.

n, the part of M between radius center and middle of chord.

C, the part of chord from its intersection of center line to end of arc.

When any two of these terms are given either one or all of the remaining terms may be determined, giving rise to no less than 360 distinct formulas.



The Laying Out of Kite Shaped Race Tracks.

But as the track should always be laid with reference to having just the required room between the poles at the wires for a judge's stand, r should be taken as one of the known quantities; also P must be a known or required term, and should appear in each formula, thus enabling us to reduce the actual formulas necessary to find all of the required terms in any given case to the following twelve, six of which are when P is required, and six when r and P are given to find one of the other terms.

For brevity we represent the variable term

$$\left(1 + \frac{P}{90}\right) \frac{3.1416}{2}$$

which appears in each formula by V.

Put L = half length of track = 2,640 ft. when track is a mile long.

Giv'n.	Req'd.	Determinate equations.	
	A	$A = \frac{L + \cot P\, r}{1 + \frac{\cot P}{V}}$	(1)
	T	$T = \frac{L + \cot P\, r}{\tan P\, V + 1}$	(2)
	R	$R = \frac{L + \cot P\, r}{V + \cot P}$	(3)
r, P	M	$M = \frac{L + \cot P\, r}{\sin P\,(V + \cot P)}$	(4)
	C	$C = \frac{\cos P\,(L + \cot P\, r)}{V + \cot P}$	(5)
	n	$n = \frac{\sin P\,(L + \cot P\, r)}{V + \cot P}$	(6)

Giv'n.	Req'd.	Transcendental equations.	
r, A		$V\,[\tan P\,(L - A) + r] = A$	(7)
r, T		$\tan P\, V + 1 = \frac{L + \cot P\, r}{T}$	(8)
r, R		$R\, V + \cot P\,(R - r) = L$	(9)
r, M	P	$\sin P\,(V + \cot P) = \frac{L + \cot P\, r}{M}$	(10)
r, C		$C\, V + \cot P = \cos P\,(L + \cot P\, r)$	(11)
r, n		$\frac{V + \cot P}{\sin P} = \frac{L + \cot P\, r}{n}$	(12)

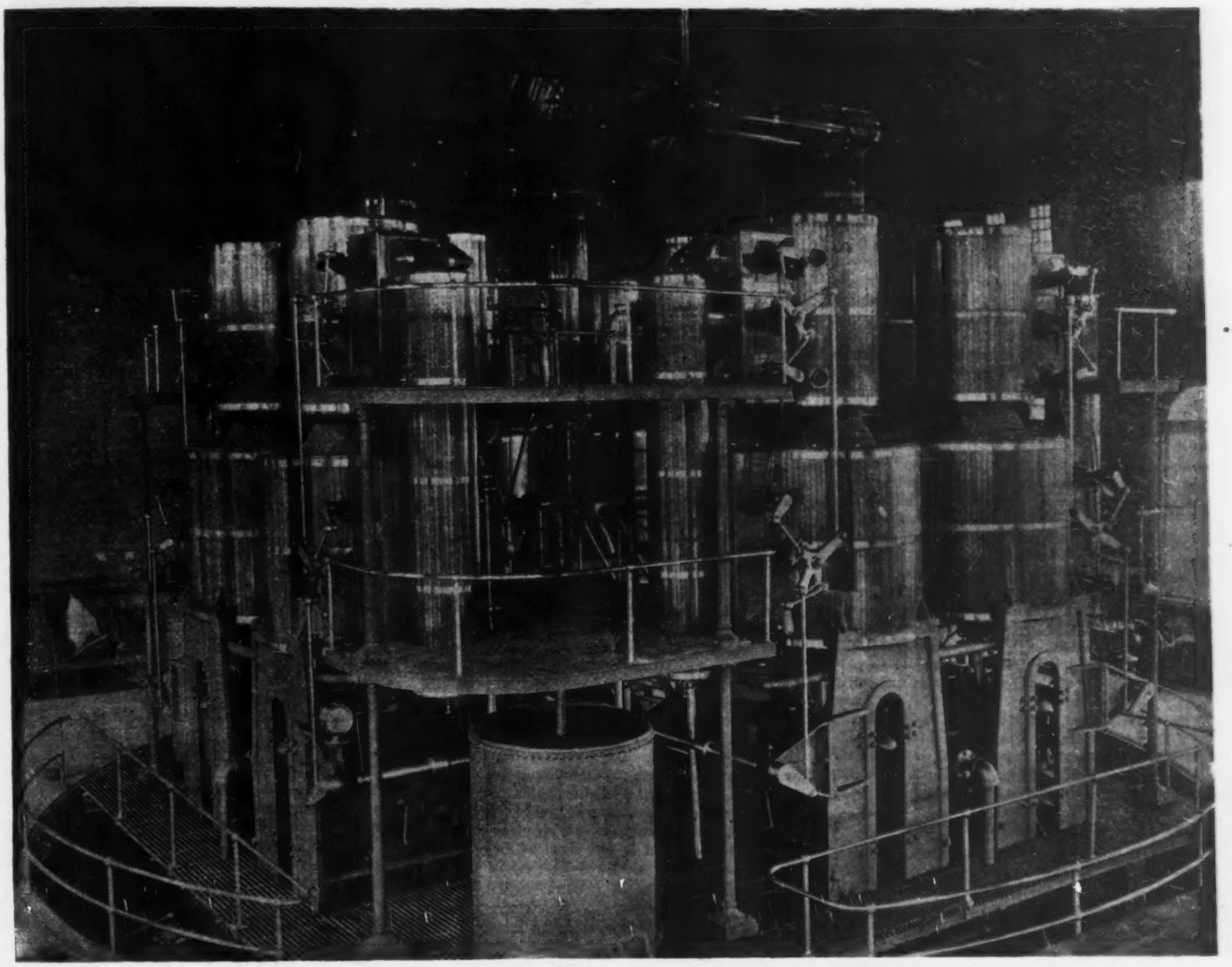
The value of P when required is found from a transcendental equation by assuming a value and applying it in the formula, then note the error: assume another value, repeat the work, and by apportioning the two errors, by position determine the true value.

After finding the angle all other terms are readily found from the determinate equations, or by the usual trigonometrical functions.

The initial steps toward a proper drainage system for New Orleans, La., were taken on May 28. A special tax of one mill is to be levied, and bonds will be issued to the amount of $250,000. The principal object sought is the removal of storm water; but some better arrangement than that now in use for the disposal of household sewage will probably be devised in connection with it.

THE WORTHINGTON WATER-WORKS PUMPING ENGINES AT PEORIA, ILL.

Connected with the new water-works at Peoria, Ill., are the three 7,500,000-gallon Worthington pumping engines shown by the accompanying photographic reproduction. These engines are of the vertical compound condensing high duty type, and are set in a pit with centers of water cylinders about 10 ft. above the lowest water level yet obtained in the well from which the supply is obtained. The pit is 40 ft. in diameter, the bottom being at grade +20 and the top at +46. The pump pit is connected with the well by a tunnel about 100 ft. long, through which the suction pipes pass.



THREE 7,500,000-GALLON HIGH DUTY WORTHINGTON PUMPING ENGINES, PEORIA, ILL.

The pumps have each two high pressure cylinders 25 ins. in diameter; two low pressure cylinders 50 ins. in diameter; two double acting water plungers, 21 ins. diameter; all of 36 ins. stroke. From the bottom of the base casting to top of steam chest is 56 ft. 6½ ins. Surface condensers are used. The steam plant consists of six Heine safety boilers, in three batteries, of combined capacity of 1,200 HP. The chimney is 155½ ft. high, square in section, 5 ft. 4 ins. across. The pumping station and chimney are well built of brick with terra-cotta trimmings.

An illustrated description of the other features of the Peoria water-works will be given in a later issue. We are indebted to Mr. W. C. Howley, Assoc. Mem. Am. Soc. C. E., for the above information.

Tests of a Vauclain four-cylinder suburban engine have been made on the Illinois Central R. R. at Chicago. The engine has six driving wheels, a leading pony truck and a six-wheel trailing truck.

AN APPALLING FALSEWORKS DISASTER.

A terrible and perhaps needed evidence of the danger of taking too many chances in erecting falseworks occurred last week at Covington, Ky., under the following circumstances:

A new highway bridge of rather unusual size and height was demanded and contracted for to connect the cities of Newport and Covington, Ky., across the Licking River, both those cities being suburbs of Cincinnati, O. The bridge consisted (apart from some short span approaches) of a single deck span of 300 ft., c. to c. end pins, the roadway being some 65 ft. above the water. It was to be used by an electric railway, and there was the usual haste to finish it as soon as possible. The contract for the masonry and erection was let by the King Bridge Co. to the firm of Baird Bros., of Pittsburg (two of whom, Robert and Andrew, have now paid the penalty of their lives for such fault or oversight as may be justly charged to them, if any). Oversight there certainly was in a sense, but whether or not there was any culpable negligence or recklessness will perhaps never be accurately known. Certainly we shall not impute any to them. It is always easy enough to be wise after the event, but a certain proportion of such accidents may reasonably be expected. The firm is a well known and experienced one. They have held and executed contracts for the Cincinnati and Newport Bridge, for the great Memphis Bridge (just completed), for three bridges across the Monongahela above Pittsburg, for part of the Davis Island dam work, and for various other important works during the past 20 years. If experience goes for anything, they were fully competent for the work they had in hand, and as little likely as anyone to make fatal mistakes. The King Bridge Co., of Cleveland, very reasonably ask us to state explicitly that they had nothing whatever to do with the erection, and hence have no shadow of responsibility for this disaster.

We have endeavored without success to obtain photographs of the work immediately before and after the disaster. We doubt if they exist, though the newspapers publish rude sketches. The falsework appears to have consisted of pile bents, 16 to 20 ft. apart, with a 40-ft. central opening to permit scow navigation. Piles about 40 ft. long are said to have been used, driven only 10 ft. in the ground, but they are more likely to have been about 30 ft. It seems tolerably clear that the immediate cause of the disaster was a great depth of soft mud on the Newport side of the river. The same length of pile was used for both sides, but whereas on one side there was no difficulty in striking good solid earth with these piles, on the other side no solid bottom was struck, but only a mud very similar in its qualities to the North River silt at New York, but much less firm, and alleged to be some 25 ft. deep. The mud resisted quick penetration, so that the hammer bounded a good deal, and yet the total penetration at each blow was very considerable, and (as now appears) far too great for safety. On the Jersey side of the North River, as is well known, it is almost or quite impossible to drive a pile by blows, but by throwing the whole weight of a scow on it it will slowly sink downward as far as desired. Thereafter

the pile is safe against any much lighter load, but any load approaching the weight thrown on it to "drive" it will cause it to sink slowly still further. Accordingly most of the Jersey City ferry houses have wedging arrangements to take up settling.

It further appears from the accounts that the sway bracing of the falseworks was very scanty, which is highly probable, as the water was deep and the piles extended but a short way above it. This alleged defect may have helped to start the disaster, but it appears to us quite certain that it was not the main cause. Had it been so the whole structure would have toppled over sidewise and it would have been thrown entirely to one side of the center line, whereas, in fact, it dropped in a heap almost vertically. The water was exceptionally high at the time, and was 20 to 30 ft. deep in the channel.

The construction of the two massive masonry piers was begun last fall. The construction of the falseworks was begun about a month ago. The falseworks were finished and erection begun on June 8. The bridge consisted of 12 panels of 30 ft. each, 5 of which were complete, and the sixth in progress, when the structure fell. Erection was begun at the center of the span.

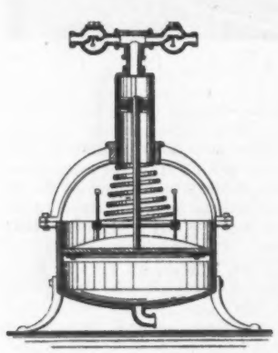
The traveler used in erection towered some 35 ft. above the top of the main trusses, and nearly 40 men were on and about it at the time of the disaster. Two days before there had been a slight warning of possible trouble in a decided "kicking" of the traveler, probably due to some settlement of the piles; but as nothing further then happened, no great importance was attached to it. Two or three of the survivors now allege that they had their doubts, but their statements are not entitled to much credence.

All accounts agree that the final disaster came absolutely without warning. Not so much as a preliminary crackling warned men to jump for their lives. Their first cause for alarm was finding themselves falling. The number of men who fell with the wreck appears to have been about 40, of whom 2 escaped uninjured, 12 were more or less seriously injured; 26 have been recovered, dead.

The collapse of the entire structure was absolute and complete except a bent and a half at the Covington end of the bridge. Otherwise not a single stick was left in place. The approach spans on each side were already erected, and stood uninjured. The total money loss by the disaster is said to be only $15,000, and most of the iron work was uninjured, or only slightly bent. The King Bridge Co. were the main contractors, but had sublet the erection to Baird Bros., which latter firm carried a blanket accident insurance policy of about $1,500 each on their working force. The death roll is still not quite certain, but seems to be about as stated.

A WATER PRESSURE PUMP.

The pump illustrated in the accompanying cut is operated by the fluctuations of pressure in a water main; and by varying the relative sizes of the large and the small pistons, a given change in pressure in the main may be made to produce any desired pressure in the delivery pipe from the pump. The great novelty of the device is that the power is taken from the main without taking any water from it. On any main where there are frequent and considerable fluctuations of pressure the device will work satisfactorily and without attention. Whether the pump would give satisfaction when attached to an ordinary service main would depend on the frequency and extent of the changes of pressure and also on how much service is required from the pump. The chief use of the device would seem to be on the force main of a pump where fluctuations in pressure occur at every stroke, and the applications which may be made in this way promise to be of considerable importance. The machine may be applied, for instance, to an ordinary steam pump or to a waterworks pumping engine, and water at any desired pressure may be obtained for feeding the boilers or other purposes. There are doubtless other situations where it could be applied to advantage. The pump was patented on May 3, 1892, by Mr. Thos. Henderson, of Dallas, Tex.



Pump Operated by Changes of Pressure in a Water Main.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

This company, like all of Mr. Westinghouse's enterprises, is making very satisfactory progress, as shown by the recent report to the stockholders. The company was reorganized in 1891, and its sales during that year, including those of its leased companies, aggregated $3,468,900. Previous to 1891 the sales were mainly confined to apparatus for incandescent electric lighting by means of the alternating current transformer system, but during the latter part of 1890 the manufacture of electric power and street railway apparatus was also begun, and during 1891 a large amount of such apparatus was manufactured and sold. The company now employs over 1,600 men, and its factories have a present capacity equal to monthly sales of $500,000, which can be increased. The company owns a large number of patents, many of them held by the earliest companies organized in this country for manufacturing electric light and power apparatus, and while it is involved in some of the litigation which, unfortunately, seems to be necessarily incidental to the ownership of all valuable patents, it has entire confidence in its patents and in the merits of its apparatus. In regard to competition, the report states that the competition which has heretofore been due to the operation of a number of companies has materially changed during the past six months, as a company has been organized to consolidate the four principal competing companies, and presumably the smaller companies controlled by the larger ones, so that the Westinghouse company has now but one important competitor. The fight for the contracts for the incandescent electric lighting at the World's Columbian Exposition, and the final award to the Westinghouse company, after a rapid scaling down of the prices bid by the "combine" of other electrical companies, was noted in our issue of June 9, and was a remarkable showing of how prices may be raised by a monopoly which does not expect competition. The aggregate value of all the electrical machinery and apparatus turned out during 1891 is given as $25,000,000, and the capacity of the company's factories can be increased at a small expenditure so as to be able to manufacture 40% of all such apparatus and machinery. The balance sheet of the Westinghouse Electric & Manufacturing Co. for March 31, 1892, shows the following: Assets, $12,402,769; liabilities, $10,522,324; surplus, $1,880,445.

CANAL AND WATER-POWER PLANT IN JAPAN.

A navigable canal with inclined planes for overcoming differences in level has recently been completed in Japan, the work having been done under the Government, and is of interest in many ways. We shall hope that the engineer of the works, or some other of our Japanese subscribers, will favor us later with particulars as to the working of this plant.

Lake Biwa, having an area of 500 sq. miles, is located 7 miles from the city of Kioto and at an elevation of 143 ft. above it. A navigable canal has been cut from this lake to Kioto, involving 2 miles of tunneling and an aqueduct of considerable length. At the eastern extremity of the city, to which point the canal has been brought, there is a sharp decline of 118 ft., from the base of which the canal is continued to the sea. This difference in level is overcome by inclined planes 2,100 ft. in length, on which boats are raised and lowered from one of the canals to the other. These ways are operated by electric power furnished from a Pelton water wheel connected with a Sprague motor.

The fall above named affords also a very valuable water power, a part of which has already been utilized for various mechanical purposes by means of electric transmission. The power station is located at the foot of the incline, and consists of three 8-ft. and two 6-ft. Pelton wheels, aggregating about 600 HP., which are supplied with water from the high level canal by three lines of 36-in. pipe 1,300 ft. in length, delivering water to the wheels under a head of about 100 ft. These wheels are at present operating three Edison dynamos of 80 K-W. each, the power from which is distributed about the city within a radius of two miles for running rice mills, spinning mills, a watch factory and various other machinery. One Thomson-Houston alternating current dynamo of 2,000 volts supplies the city with 1,300 incandescent lights as well as many arc lights.

The above works, involving an expenditure of $1,500,000, were planned by and executed under the direct supervision of Mr. S. Tenabe, an eminent Japanese engineer, and their operation is said to be a great success both from a mechanical and financial point of view.

COMPOUND LOCOMOTIVE TESTS.

The committee of the Master Mechanics' Association which has had in charge the subject of compound locomotives made a report to the convention at Saratoga just closed, showing the results thus far obtained in the extensive series of tests which is in progress under the committee's direction. The complete report contains 36 pages, 9 large tables and 5 plates, besides other illustrations, and is of much value and interest, if not entirely conclusive. The report is certainly entitled to the adjective exhaustive, as every reader who studies it thoroughly will

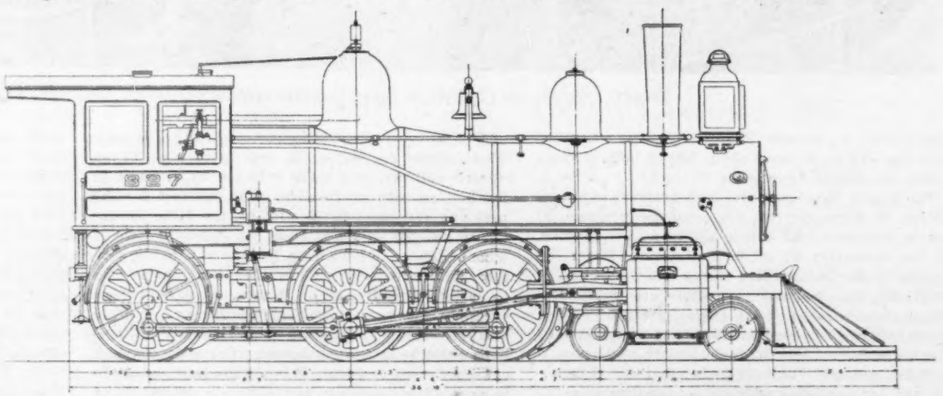


FIG. 1. SIDE ELEVATION OF VAUCLAIN COMPOUND LOCOMOTIVE.

agree. Nevertheless, it is not really verbose; but the committee have deemed it necessary to record all the circumstances of the tests with a minuteness of detail for which few readers will care, but which is entirely proper in an original record. Necessarily the important results of the tests are somewhat obscured by this treatment; but the committee was hardly to blame for this, as lack of time prevented the digesting and summarizing of the record which was desirable. We abstract the salient points in the report as follows:

There are three important considerations attending the use of compound locomotives: 1. Relative convenience and economy of first cost and repairs compared with simple engines. 2. Relative fuel economy, starting power, etc. 3. The practicable ratio between the cylinder volumes obtained with each and their influence with condition 2. The tests of the committee, however, have thus far been confined to a determination of the fuel economy. The Baldwin Locomotive Works built for the committee two 10-wheel freight locomotives of the standard "class D" type in use on the Chicago, Milwaukee & St. Paul Ry. The two engines were identical in every respect except that one had compound cylinders arranged on the Vauclain system, and the other had cylinders of the ordinary pattern. The two engines were run between Milwaukee and Portage in the C., M. & St. P. freight service on the "first in, first out" system, so that each handled sometimes through freight and sometimes locals.

The main dimensions of the two engines are shown in the accompanying table, and Figs. 1 and 2 show an elevation, section and rear view of the compound engine:

	Compound, 827.—h. p. cyl.	l. p. cyl.	Simple, 822.
Cylinders	12 × 26	20 × 26	18 × 26
Valves, outside lap	1 in.	1 in.	1 in.
" inside lap	0	0	0
" lead	1/8 in.	3/8 in.	1/8 in.
" travel, full gr.	4 1/4 in.	4 1/4 in.	5 1/2 in.
Steam ports, width	1 1/4 in.	1 1/2 in.	1 1/4 in.
" " diam	9 1/4 ins.		17 1/8 ins. length
Exhaust port, width	3 1/2 ins.		3 ins.
Throw of eccentrics	2 5/8 ins.		2 5/8 ins.
Length of eccentric rod	4 ft. 8 3/4 ins.		4 ft. 8 3/4 ins.
Firebox, size	6 ft. 6 ins. × 2 ft. 10 ins.		6 ft. 6 ins. × 2 ft. 10 ins.
" depth	6 ft. 5 in.		6 ft. 5 ins.
Grate area	18.4 sq. ft.		18.4 sq. ft.
Tubes, l'gth (betw. sheets)	13 ft. 7 1/8 ins.		13 ft. 7 1/8 ins.
" diam., outside	2 1/4 ins.		2 1/4 ins.
" number	191		191
Diam. smokestack	16 ins.		16 ins.
" drivers	5 ft. 2 ins.		5 ft. 2 ins.
Exhaust nozzles	3 1/8 ins. double		3 1/8 ins double
Heating surface, tubes	1,576.6 sq. ft.		1,576.6 sq. ft.
" " firebox	135.5 sq. ft.		135.5 sq. ft.
" " total	1,712.1 sq. ft.		1,712..1 sq. ft.
Ratio h't'g surf. to grate	9.3 to 1		9.3 to 1
Weight on drivers	87,970 lbs.		86,200 lbs.
" " truck	34,430 lbs.		23,800 lbs.
Total wt., working order	122,400 lbs.		120,000 lbs.

Unfortunately, however, it was found too late that, by what the committee delicately term "a misunderstanding of their wishes," the two engines had not been designed to work at the same boiler pressure, which is clearly necessary in order to determine the advantage of compounding by itself. The compound was designed for 200 lbs. and the simple for 180 lbs. The committee "endeavored to remedy this unfortunate mistake by running both engines at 180 and 200 lbs. pressure," but it is clear that this does not fully accomplish the end, and that perhaps the fairest way is to compare the performance of the two at the boiler pressures for which they were designed.

The main details of the Vauclain compound locomotive were fully illustrated and described in our issue of Feb. 20. The starting valve gear was not shown so completely, however, and is thus described in this report:

Figs. 3 to 5 give general plans and details of the Vauclain starting-valve and cylinder cock rigging. It consists of a casing with a piston-valve inside. The casing is placed below the lower cylinder in the usual position of the whole number of trips. This figure, however, includes runs with both Pittsburg and Braceville coal, the former a hard bituminous, the latter representing much more nearly the average grade of coal in use on locomotives. With Braceville coal the average economy of the compound engine over the simple was 16.9% coal and 14.1% water economy. These figures, the committee believes, more nearly represent the average monthly or yearly economy to be derived from compound engines in ordinary service than the first figures given.

As this is really one of the most important facts which were developed in the committee's investigations, we quote as follows from their report:

Two important divisions of the tables are those giving results with use of Braceville and with Pittsburg coal. The former may be considered a fair example of good Western coal, used by roads in the territory west of Chicago. The main portion of test was therefore conducted with this coal. In order, however, to test the steaming qualities of the engines with the best sample of Pennsylvania coal, it was decided to make a few trips with Pittsburg coal.

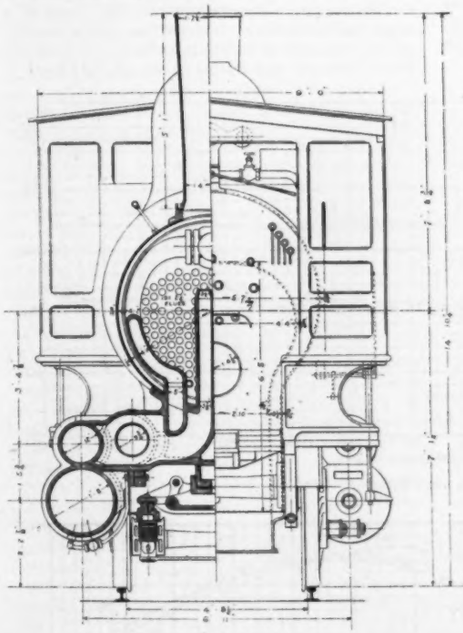
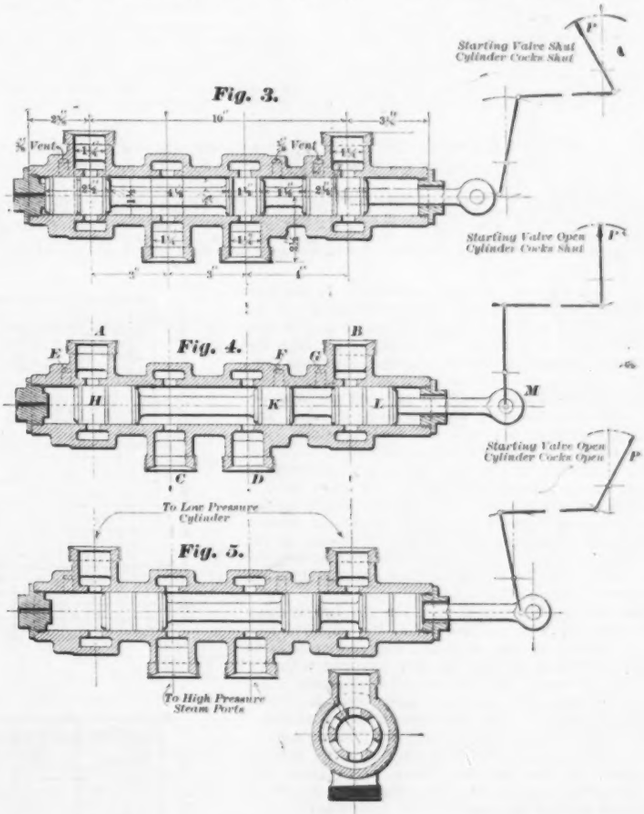


FIG. 2. SECTION AND REAR ELEVATION OF VAUCLAIN COMPOUND LOCOMOTIVE.



FIGS. 3, 4 AND 5. VAUCLAIN STARTING VALVE AND CYLINDER COCK RIGGING.

cylinder-cocks, and the rod of the piston valve is attached at M to a lever rigging up to the cab, where it terminates in a handle at P. This handle has three positions: First, shown in Fig. 3, where both starting-valve and cylinder-cocks are closed; second, in Fig. 4, starting-valve open, cylinder cocks still closed; third, in Fig. 5, starting-valve and cylinder cocks both open. The ports A and B are connected to the drainage ends of the low-pressure cylinder; the ports C and D to high-pressure steam ports in the main valve. The vents for condensation are shown at E, F and G.

Referring to Fig. 3, it will be seen that the pistons H and L fully cover the openings to the low-pressure cylinder, while the piston K covers the opening from one side of the high-pressure; steam is therefore shut off from communication between the two cylinders and from the condensation vents. In Fig. 4 the valve is moved half stroke, still, however, covering the low-pressure exits, but uncovering the port D, throwing the two ports C and D in communication, permitting steam from the inlet end of the high-pressure cylinder to travel through the starting-valve to the exhaust end of the high-pressure cylinder, and, consequently, into the inlet of the low-pressure, thus mixing live steam with the partially expanded steam. In Fig. 5 the piston valve has traveled to its extreme position and opened the vents of the low-pressure cylinder, while leaving the live steam inlet also open. The starting-valve may be opened without opening the cylinder cocks, but the latter cannot be opened without admitting live steam into the low-pressure cylinder. Further, the rigging is so arranged that the starting-valve may be kept open at will for any length of time with the reverse lever in any position.

Since March 31, 60 trips have been run with these two engines, on which all the necessary data for the computation of fuel economy have been taken. On every trip a dynamometer car specially built for the tests has been drawn just back of the tender, and the foot-tons of work done on the train have been computed from its records.

As might be expected, the tests being made with a great variety of trains, some local and some through, and of greatly varying weights, they show great variation in their results. The fuel economy of the compound over the simple engine varies from a minus quantity to 29.1% and averages 7.6% on

Much has been said about the characteristic exhaust obtained from the compound locomotive; in the two-cylinder compound especially, there is obtained one pulsation of exhaust to two in the simple engine. The character of this pulsation as observed by the sound of the exhaust and by the vacuum in front end, is very different from that of the simple engine, and tests with the two-cylinder compound, previously made, had showed a certain percentage of steam economy obtained, and an additional percentage of fuel economy, indicating that the softer exhaust was in some way

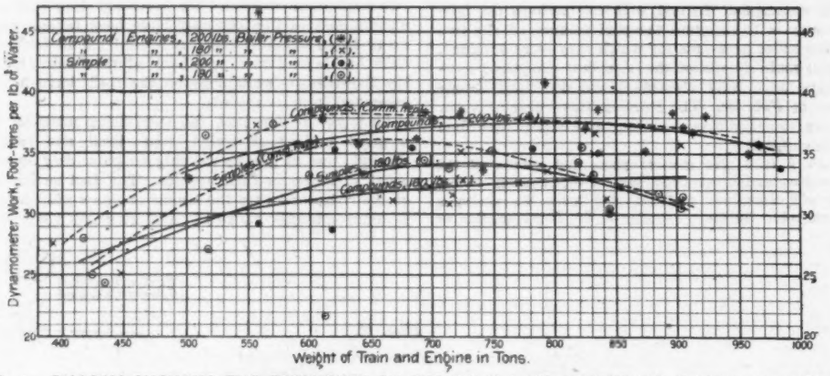

Compound Engines, 200 lbs. Boiler Pressure, (⊕).
" " " 180 " " " (×).
Simple " " 200 " " " (●).
" " " 180 " " " (⊙).
Compounds, (Comm. tests).
Compounds, 200 lbs. (⊕).
Simples, (Comm. tests).
Simples, 180 lbs. (⊙).
Compounds, 180 lbs. (×).
Dynamometer Work, Foot-tons per lb. of Water.
Weight of Train and Engine in Tons.

FIG. 6. DIAGRAM SHOWING THE EFFICIENCY OF THE SIMPLE AND COMPOUND ENGINE IN TERMS OF FOOT-TONS OF DYNAMOMETER WORK PER POUND OF WATER AT 212°.

(The dotted curved lines show the means adopted by the committee, throwing out eight of the tests of the compound engine with 180 lbs. boiler pressure for "defective running." These lines give means for all observations of the simple or compound engine, whether at 180 or 200 lbs. boiler pressure. All the rest of the diagram we have constructed independently. It shows the result of every test made for each boiler pressure and each kind of engine, by symbols explained on the diagram, and the means which seemed to us most warranted by solid curved lines.)

responsible for more efficient combustion. In the four-cylinder compound, while the pulsations are of the same number as in the simple engine, it was thought the difference in volume of steam discharged from low pressure cylinder and its lower average terminal pressure, might exert a similar action on the fire, so that while the compound might show fuel economy with the free burning clinkering Western coal, it might give very different results with the hard Pittsburg coal. It is, further, well known that on account of the clinkering properties of the Western coal, to successfully burn it and prevent clogging of the grate bars, a sharper exhaust must be used than is needed for the non-clinkering Eastern coal. It, therefore, seemed reasonable to suppose that the softer exhaust in the compound would operate to disadvantage in burning the Western coal; hence the results shown in the tables are somewhat unexpected.

The size of the nozzles used for the two engines was different. The C., M. & St. P. Ry. standard nozzle is double, 3¾ ins. diameter, and has been carefully designed to produce the best steaming with the kind of coal employed. The compound originally fitted with this nozzle did not steam freely with Braceville coal until the nozzle was reduced to 3¼ ins. With Pittsburg coal it could be enlarged to 3⅝ ins., but no more.

The effect of using Pittsburg coal in the two engines is shown in the following table, which gives the percentage of economy so obtained in each engine as compared with its performance with Braceville:

Engine No.	Coal per HP. hour.	Water per HP. hour.
822 (simple).....	28%	9.2%
827 (compound)...	19%	6.

It is thus seen that in changing from Braceville to Pittsburg coal, the improvement in economical performance was greater with the simple than with the compound engine. In the opinion of your committee the explanation of the greater improvement of the simple engine is that with the friable Braceville coal its sharp exhaust as compared to that of the compound, caused a considerable proportion of the fine coal to be drawn through the flues unconsumed. With the harder Pittsburg coal this did not obtain to so great an extent in either engine, and it necessarily follows that the gain from suppression of waste would be more marked with the simple engine, as is shown in the table. As a consequence your committee feel justified in predicting that in future trials the greatest gain in compounding will be found where coals used are of a dusty or friable nature.

It seems probable, as a general review of the entire question, that the results given with Pittsburg coal represent the simple engine as its most favorable condition. On the other hand, they are strongly of the opinion that the large number of trips represented by the tests with Braceville coal quite nearly approximate the condition laid down as most desirable at the outset of the report, that is, average monthly or yearly economy, to be derived from compound engines. This figure is shown to be 16.9% coal and 14.1% water economy.

In further explanation of the general results as to fuel economy obtained from the tests, the committee exhibited two diagrams which we reproduce herewith (Figs. 6 and 7), plotted from the dynamometer records of the work done on the train in foot-tons per pound of coal burned and per pound of water evaporated. After studying these diagrams and discarding from them tests which were made under conditions specially favorable or unfavorable, the curve for the average economy of each engine was traced on each diagram, its exact position, of course, being to a considerable extent a matter of judgment.

The accompanying Figs. 6 and 7 are by no means in the form prepared by the committee and submitted to the association. As explained in the titles to the cuts, the dotted curved lines only show what they submitted. We have taken the liberty to divide the observations into four classes instead of two, to use all the observations instead of a part only, and to construct anew what seemed to us the mean curves for each of these four sets of observations, except for one class, where the number of observations seemed to be too few to establish a curve with any approach to certainty.

It must be understood that these curves are designed only to show the nearest possible mean of the observations as they stand. Whether they were consistent with each other was not our concern. In part they are not consistent, though their seeming inconsistencies are in part easily explicable, and much less than they seem.

Inasmuch as the simple engine was designed to work at 180 lbs. boiler pressure and the compound at 200 lbs., it seems to us that by far the most weight should be attached to the runs made at the pressure for which the engine was designed. It is obviously unfair to work an engine in a comparative test at a pressure 20 lbs. higher or lower than it was designed for. At any rate, we give the material for forming a judgment on this point by showing separate mean lines for the 180-lb. and 200-lb. tests for both the simple and compound engines.

The pressure upon our time and space is too great this week for us to review these tests, or even present all the facts in regard to them, as we should wish to do, or as we hope to do in a following issue. In the meantime these diagrams will bear study as establishing beyond peradventure that there is a large coal economy in compounding, and a sacrifice of coal economy from heavy loading only when the coal is of a soft and friable nature, so that much of it blows out the chimney when working heavily.

Some of the dynamometer diagrams given with this report are of interest as showing certain facts as to the handling of trains having no direct connection with the purpose for which they were taken. We shall show these later in a separate article.

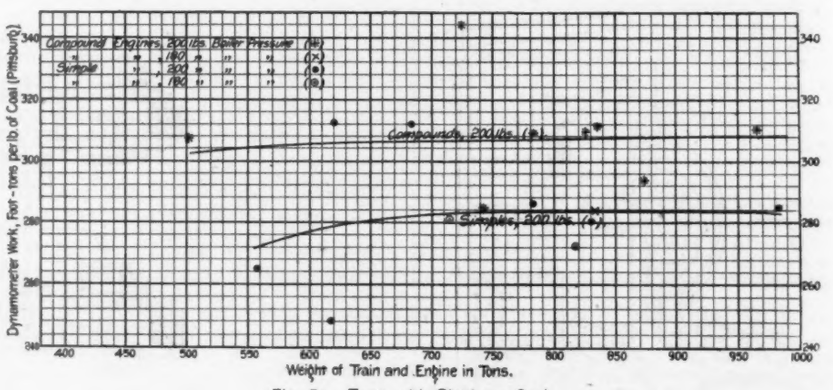

Compound Engines, 200 lbs. Boiler Pressure (⊕).
" " " 180 " " " (×).
Simple " " 200 " " " (●).
" " " 180 " " " (⊙).
Compounds, 200 lbs. (⊕).
Simples, 200 lbs. (●).
Dynamometer Work, Foot-tons per lb. of Coal (Pittsburg).
Weight of Train and Engine in Tons.

Fig. 7a. Tests with Pittsburg Coal.

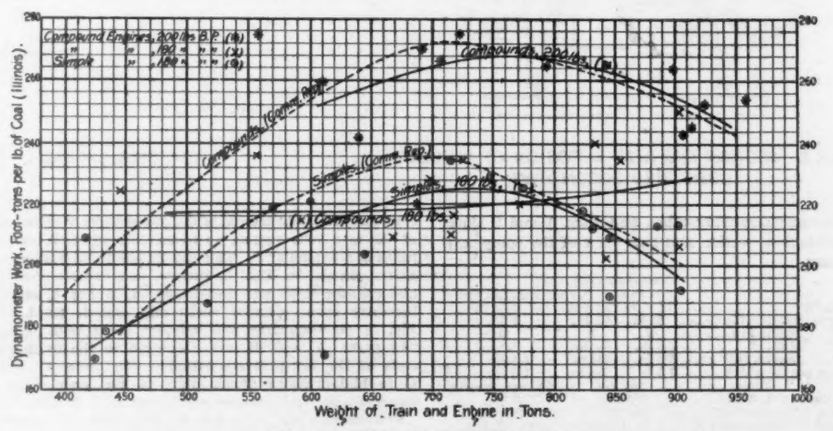

Compound Engines, 200 lbs. B.P. (⊕).
" " 180 " " " (×).
Simple " " 180 " " " (⊙).
Compounds, 200 lbs. (⊕).
Compounds, (Comm. tests).
Simples, (Comm. tests).
Simples, 180 lbs. (⊙).
Compounds, 180 lbs. (×).
Dynamometer Work, Foot-tons per lb. of Coal (Illinois).
Weight of Train and Engine in Tons.

Fig. 7b. Tests with Braceville Coal.

FIG. 7. DIAGRAMS SHOWING THE EFFICIENCY OF THE SIMPLE AND COMPOUND ENGINE IN TERMS OF FOOT-TONS OF DYNAMOMETER WORK PER POUND OF COAL BURNED.

(See note to Fig 6, which applies verbatim to Figs. 7a and 7b also.)

The report was signed by the committee, Messrs. Geo. Gibbs, Wm. H. Lewis, Pulaski Leeds, Jas. Meehan, F. D. Casanave, Arthur T. Woods. To Mr. Gibbs, however, belongs the credit for the conduct of the tests and the preparation of the report.

The discussion on this report was opened by Mr. S. M. Vauclain, Superintendent of the Baldwin Locomotive Works and the inventor of the compound locomotive tested by the committee. He said that the Baldwin Locomotive Works have now over 200 compound locomotives in service and a number of others building, which is four or five times as many as any other builder in this country has to his credit. Mr. Gibbs' test has been a thoroughly impartial and a crucial one, and the Baldwin works are satisfied to stand on the records obtained. There are now so many engines of this type in service, however, that figures as to the relative economy of the compound are very numerous. The figures for the economy of the compound over the simple vary all the way from moderate figures up to 44.9%. This last record has been made on the Western Maryland R. R. on a 2% grade 12 miles long, where both engines are worked at full stroke and to the utmost limit of their capacity. (It seems probable that this extra large percentage is mainly due to the softer exhaust of the compound blowing less coal out of the chimney, and hence in good part justified.—Ed.)

Mr. Vauclain remarked that there is a somewhat prevalent idea that the compound locomotive is only adapted to certain kinds of service. To combat that idea it may be stated that the Baldwin Works have built compound locomotives from 23 ins. gage to 5 ft. 6 ins. gage, and with cylinders varying from 4 ins. in diameter to 24 ins. (or the equivalent of a simple engine of those sizes). The New York, Lake Erie & Western now has five compound locomotives which are the equivalent of a 24×28-in. cylindered simple engine. These engines are hauling freight trains where the work is so hard that one man could not fire them if they were simple engines. So much for the heaviest freight service. Not long ago the Baldwin Works offered to build a fast passenger compound for the Central R. R. of New Jersey, and permit it to be run on trial for two months. At the end of 60 days a check came for the locomotive, with an order for four more. (Mr. Vauclain might have added that one of these engines now holds the record for high speed.—Ed.)

The fact is that the sensible way to test the compound locomotive on a road of any size is to order not one engine, but 5, 10, 15 or 20, and put them to work like any other engines. Then let the monthly performance sheets tell the story of which is the better locomotive. The Philadelphia & Reading has taken this wise course. It has 27 Vauclain compounds in service.

With reference to the small difference between the simple and compound locomotives in the Master Mechanics' Committee's tests, Mr. Vauclain thought that it might have been due to improper draft arrangements. He could not understand, however, why there should be such a variation in water consumption per horse power with the different sorts of coal.

Mr. Pitkin, of the Schenectady Locomotive Works, called attention to the report of Mr. H. J. Small to the committee concerning performance of Schenectady compounds on the Southern Pacific. The two-cylinder compound has been criticised on account of variation in power exerted by the two cylinders. Since building the Southern Pacific engine this has been rectified, and the maximum difference in power between the two cylinders of a Schenectady compound is now only 3%. Of the 55 compound locomotives sold by the Schenectady Works, the orders for all but three were received without solicitation. The orders for the two first put on the Michigan Central and one just built for the Pennsylvania were asked for by the builders.

Simplicity is the main point to be sought for in the compound locomotive, and the survival of the fittest will determine which type is best. The fuel economy secured varies from 15% to 30%, according to conditions of service.

Mr. Lythgoe, of the Rhode Island Locomotive Works, said they had built quite a number of compounds of the two-cylinder type which had shown a saving in service of 15% to 37%. Reports just received from the Brooklyn Elevated, where three of these compounds are running, show a fuel saving in 15,000 miles service of 27% as compared with the simple engines of the same dimensions and build in the same service. One fast passenger compound from the Rhode Island Works is now running on the New York, Providence & Boston. The works have also built some of the Johnstone four-cylinder compounds, and are now building ten of this type, part for the Mexican Central and part for another road.

Mr. D. L. Barnes said that a telegraphic dispatch from an engineer in his employ who had just made some tests on the Mexican Central compounds showed an economy of 15 to 30%. Mexican prices for fuel are so high that at this rate the saving made by the use of the compound locomotive would amount to about $15,000 per year per locomotive.

Mr. H. Tandy, of the Brooks Locomotive Works, said they had built one 2-cylinder compound, which had been running in freight service since last September, showing 27 to 33% gain in economy, and has been recently put into heavy passenger service. The works are now building a four-cylinder compound principally for their own amusement (and instruction?—Ed.). They are ready to build compound locomotives whenever their customers desire.

Mr. F. W. Dean said the Old Colony compound has a ratio of cylinder areas of 1.97 to 1. The diameters are 20 and 28 ins. He had many misgivings that the high pressure cylinder ought to have been 19 ins., but results in service have convinced him that the ratio is all right.

Mr. F. D. Casanave said there were only four or five compounds on the Pennsylvania system and few tests of economy had been made. One test, however, showed a fuel economy of about 5%. In taking up the question of compound locomotives the cost of repairs must be considered as well as the saving of fuel. He hardly thought, if he were taking money out of his pocket for railway equipment at the present time, that he would go very extensively into compound locomotives. (Applause.)

Mr. Paxton said that the 27 locomotives in use on the Philadelphia & Reading were of three classes. No scientific tests had been attempted, but a close record had been made of the coal used per month as on all engines. Of the 27 locomotives, 12 are in use on heavy mountain grades and are designed to be the equivalent of 22×24 in. simple consolidations; 10 are in somewhat lighter service and correspond to 20×24 in. consolidations; 5 are in fast passenger service, of which 1 has been running two months and the others are just received. The monthly coal record shows:

Class of engine.	No.	Gain in fuel economy.
Mountain locomotives	12	25 to 30%
Heavy freight service	10	12 to 17%
Fast passenger	5	9 to 11%

They had no trouble whatever in the use of the engines except a little in breaking the men in to run them.

STATISTICS SHOWING THE PROGRESS AND PROSPECTS OF RAILWAY CONSTRUCTION IN THE SOUTHERN STATES.

(With Map No. 43.)

Virginia.—Existing Roads.

1. Abingdon Coal & Iron.—Under construction. Abingdon to Damascus, 15 miles. Projected, Abingdon to Mendota, 24 miles. Ch. Engr., J. C. Watson, Jr., Abingdon.

2. Baltimore & Ohio.—Surveyed, Lexington to Roanoke, 50 miles. Ch. Engr., H. T. Douglass, Baltimore, Md.

3. Bristol Belt.—Track laid in 1891, around city of Bristol, Tenn., 5 miles.

Chesapeake & Ohio.—Track laid in 1891, Bessemer to Craig City, 26.5 miles; Covington to Hot Springs, 25 miles. Under contract, New River Branch, 4 miles; Keeney Creek Branch, 5 miles.

4. Danville & East Tennessee.—Surveyed, Danville to Bristol, Tenn., 175 miles. Gen. Man., T. W. M. Draper, 45 Broadway, New York City.

Glasgow Belt.—Track laid in 1891, at Glasgow, 1.5 miles.

5. Louisville & Nashville.—Track laid in 1891, extension to Norton, 38 miles.

Lynchburg Belt.—Under construction, belt railway at Lynchburg, 2.25 miles.

6. Norfolk & Western.—Track laid in 1891, extension to Norton, 8.7 miles; Roanoke Belt line, 1.8 miles. Partly graded, Great Outburst to North Carolina line, 20 miles. Under construction, Ivanhoe to Speedwell, 18 miles; belt line at Roanoke, 6.75 miles; at Christiansburg, 3 miles; Coeburn to coal mines, 2 miles; branch up Russell Creek, 2 miles. Surveyed, branch to Massanutton Mt., 3 miles; Front Royal to Washington, 70 miles. Ch. Engr., W. W. Coe, Roanoke.

7. Orange & Keysville.—Surveyed, Keysville to Arvonia, 50 miles. Ch. Engr., W. A. Dafter, Farmville.

8. Roanoke & Southern.—Track laid in 1891, North Carolina line to Roanoke, 75.7 miles. This railway is leased by the Norfolk & Western R. R. Co.

9. Roanoke, Fincastle & Clifton Forge.—Under construction, Fincastle to Cloverdale, 12 miles. Projected, Roanoke to Clifton Forge, 35 miles. Ch. Engr., Jas. K. Brown, Roanoke.

Projects and Surveys.

Augusta, Highland & Alleghany.—Projected, Staunton to Monterey, 46 miles. Pres., W. D. Rippetoe, Buffalo Gap.

Blacksburg.—Projected, Blacksburg to Roanoke, 32 miles. Pres., J. F. Christian, Roanoke.

10. Bedford & James River.—Surveyed, Bedford to James River, 22 miles. Sec., W. S. McKinney, Bedford City.

11. Bristol & Northern.—Under survey, Bristol, Tenn., to Cleveland, 35 miles. Ch. Engr., Geo. S. Bruce, Bristol, Tenn.

12. Gladesville.—Under survey, Norfolk & Western R. R. to Gladesville, 12 miles. Pres., J. M. Fuller, Wise Court House.

13. Marion & Rye Valley.—Under construction, Marion southeast, 7 miles. Surveyed up Rye Valley, 40 miles. Ch. Engr., W. C. Foster, 52 Broadway, New York City.

Richmond & Chesapeake.—Projected, Richmond to Wicomico, 50 miles.

Total.—Track laid in 1891, 182.2 miles. In process of construction, 97 miles. Surveyed or under survey, 446 miles. Projects of some promise, 175 miles.

North Carolina.—Existing Roads.

Asheville & Craggy Mt.—Track laid in 1891, Asheville to Craggy Mt., 2.5 miles.

14. Atlantic Coast Line.—Track laid in 1891, Fayetteville south, 21.25 miles; Rowland north, 8.75 miles. Track laid since Jan. 1, 1892, between Fayetteville and Rowland, 12.6 miles; Albemarle & Raleigh Junction to Washington, 25 miles. Surveyed, Hub to Lumberton, 13 miles. Projected, Springhope to Durham, 45 miles; Kingston to Jacksonville, 35 miles.

15. Brunswick, Western & Southern.—Under construction, Wilmington to Southport, 25 miles. Pres., Geo. L. Dunlap; Secy., Geo. H. Bliss; both of Chicago, Ill.

16. Cape Fear & Yadkin Valley.—Graded, Mt. Airy to the Virginia line, 7.5 miles. (Work suspended.) Ch. Engr., H. L. Fry, Greensboro, N. C.

17. Carolina Manufacturing, Mining & Improvement Co.—Graded, Sylvia to Webster, 4 miles. Located, Webster to Savannah Creek, 10 miles. Ch. Engr., H. M. Ramseur, Webster.

18. Charleston, Cincinnati & Chicago.—Partly graded, Tennessee line to Marion, 70 miles. (Work suspended.)

19. Lower Creek & Linville Valley.—Track laid in 1891, Lenoir to Nelsons, 7.5 miles.

20. Norfolk & Carolina.—Surveyed, Avoca to Aulander, 34 miles.

21. Oxford & Coast Line.—Under construction, Oxford to the Durham & Northern R. R., 4.5 miles. Ch. Engr., Ashton H. Chapman, Oxford.

22. Richmond & Danville.—Track laid in 1891, Tomotla to Murphy, 8.2 miles; Bilesville to Norwood, 17 miles; Winston to Mocksville, 25.35 miles. Projected, Mocksville to Moorsville, 38 miles.

14. Wilmington & Weldon.—Track laid in 1891, Pendleton to Murfreesboro, 6.5 miles.

14. Wilmington, Chadbourn & Conway.—Track laid in 1891, Chadbourn to Hub, 9 miles. This line is now a part of the Atlantic Coast Line System.

23. Wilmington, Onslow & East Carolina.—Under survey, Jacksonville to New Berne, 38 miles.

Projects and Surveys.

24. Asheville & Bristol.—Projected, Asheville to Bristol, 75 miles. Pres., Wm. M. Cocke, Jr.; Secy., A. S. Eskridge; both of Asheville.

25. Concord Southern.—Projected, Concord to Monroe, 35 miles. Pres., J. M. Odell; Secy., W. M. Smith; both of Concord.

26. Norfolk, Wilmington & Charleston.—Surveyed, Norfolk, Va., to Charleston, S. C., 352 miles. Pres., J. C. McNaughton; Ch. Engr., F. L. Pitman; both of 212 South Third St., Philadelphia, Pa.

27. Southern & Western Air Line.—Surveyed, Shelby to Linville, 100 miles. Pres., S. McD. Tate, Morgantown.

28. Thomasville, Silver Valley & Pee Dee.—Projected, Winston to Wadesboro, 99.25 miles. P. C. Thomas, Thomasville.

Total.—Track laid in 1891, 106.0 miles. Track laid since Jan. 1, 1892, 38 miles. In process of construction, 111 miles. Surveyed or under survey, 457 miles. Projects of some promise, 377 miles.

South Carolina.—Existing Roads.

29. Ashley River.—Track laid in 1891, Ashley Junction to Phosphate works, 4.5 miles.

14. Atlantic Coast Line.—Under survey, Rimini to Orangeburg, 25 miles.

30. Bishopville.—Track laid in 1891, Bishopville to Lucknow, 8 miles.

31. Branchville & Bowman.—Track laid in 1891, Branchville to Bowman, 11 miles.

32. Carolina, Knoxville & Western.—Track laid in 1891, terminus to Marietta, 2.23 miles.

33. Carolina Midland.—Track laid in 1891, Barnwell to Allendale, 17 miles. Surveyed, Seivern to Batesburg, 16 miles.

34. Charleston, Sumter & Northern.—Track laid in 1891, Sumter to 6 miles south of Bennettsville, 56 miles. Surveyed, Bennettsville to Gibson Station, 11¼ miles. Projected, Etawville to Charleston, 50 miles.

35. Columbia, Newberry & Laurens.—Track laid in 1891, Jalapa to Dover, 13.5 miles.

36. Pickens.—Under construction, Easley to Pickens, 9.5 miles. Pres., Julius E. Boggs, Pickins.

37. South Bound.—Track laid in 1891, Columbia to the Savannah River, 107 miles. Projected, Columbia to Monroe, N. C., 75 miles. Ch. Engr., Geo. D. Wadley, Savannah, Ga.

14. Wilmington & Weldon.—Under construction, Latta to Clio, 18 miles.

Projects and Surveys.

38. Bennettsville & Society Hill.—Surveyed, Bennettsville to Society Hill, 11 miles. Ch. Engr., Thos. S. Lucas, Society Hill.

39. Cape Fear & Cincinnati.—Projected, Southport to Greenville, 275 miles. Pres., Frank Brown; Ch. Engr., Geo. B. Morton, Baltimore.

40 Carolina Southern.—Projected, Cheraw to Sumter, 65 miles. Ch. Engr., Wm. Monoure, Durham.

41. Chesterfield & Lancaster.—Projected, Cheraw to Lancaster, 55 miles. Pres., W. A. Evans, Hornboro.

42. Lockhart Shoals.—Surveyed, Jonesville to Lockhart Shoals, 16 miles. Pres., C. D. Farrar; Ch. Engr., Glenn D. Peake; both of Union.

Total.—Track laid in 1891, 219.23 miles. In process of construction, 27 miles. Surveyed or under survey, 189 miles. Projects of some promise, 470 miles.

Georgia.—Existing Roads.

43. Abbeville & Waycross.—Track laid in 1891. Bowen's Mill to Lulaville, 5.5 miles. Projected, Lulaville to Du Pont, 55 miles. Pres., J. D. Maynard, Abbeville.

44. Albany, Florida & Northern.—Track laid in 1891, extension to Cordele, 15 miles.

45. Chattanooga Southern.—Track laid in 1891, end of '90 truck to Alabama line, 7 miles.

46. Chickamauga & Durham.—Track laid since Jan. 1, 1892, Chickamauga to Durham, 17.5 miles. Under construction, Durham to Ft. Payne, Ala., 28 miles. Ch. Engr., John I. Henderson, Chickamauga.

47. Douglas & McDonald.—Under construction, Douglas to McDonald, 18 miles.

48. Empire to Dublin.—Partly graded. Hawkinsville to Grovania, 13 miles. (Work suspended.)

49. Flovilla & Indian Springs.—Track laid in 1891, Flovilla to Indian Springs, 8 miles.

50. Georgia, Carolina & Northern.—Track laid in 1891. Savannah River toward Atlanta, 95 miles. Track laid since Jan. 1, 1892, extension to Atlanta, 23 miles.

51. Georgia Southern & Florida.—Surveyed, Tifton to Thomasville, 52.5 miles; La Grange to Birmingham, Ala., 133 miles.

52. Macon & Atlantic.—Track laid in 1891, mile 58 to mile 69, 11 miles. Located, Macon to mile 58, 58 miles; mile 69 to Colleton, S. C., 114 miles. Ch. Engr., Wm. H. Wells, Macon.

53. Macon, Dublin & Savannah.—Track laid in 1891, Dry Branch to Dublin, 44 miles.

54. Middle Georgia & Atlantic.—Partly graded, Newborn to Social Circle, 10 miles. (Work suspended.) Surveyed, Eatonton to Savannah, 170 miles. Projected, Covington to Atlanta, 35 miles. Ch. Engr., Arthur Pew, Savannah.

55. Millen & Southern.—Track laid in 1891, Thrift to Millen, 11.5 miles.

56. Savannah, Americus & Montgomery.—Under survey, Lyons to Savannah, 75 miles.

57. South Bound.—Track laid in 1891, Michord to the Savannah River, 20 miles.

57. Tifton & Northeastern.—Track laid in 1891. Tifton to Irwinsville, 13 miles. Projected, Irwinsville to Abbeville, 35 miles.

58. Way Cross Air Line.—Surveyed, Way Cross to St. Marys, 60 miles. Ch. Engr., J. T. Stone, Cordele.

Wrightsville & Tennille.—Track laid in 1891, in the vicinity of Dublin, 1 mile.

Projects and Surveys.

59. Albany, Boston & Florida.—Projected, Albany to Boston, 90 miles. J. N. Taylor, Boston.

60. Atlanta & Alabama.—Surveyed, Atlanta to Selma, Ala., 204 miles. Pres., Henry B. Tomkins; Secy., L. E. O'Keefe; both of Atlanta.

61. Atlantic & Northwestern.—Surveyed, Augusta to Chattanooga, Tenn., 240 miles. Pres., R. M. Mitchell, Augusta.

62. Brunswick, St. Mary's & Florida.—Projected, Brunswick to Harts Road, Fla., 40 miles.

63. Cartersville & Gainesville.—Projected, Cartersville to Gainesville, 73 miles. Ch. Engr., Parker N. Black, Atlanta.

64. Madison & Eatonton Dummy.—Projected, Madison to Eatonton, 22 miles. J. H. Holland, Madison.

65. Smithsonia. Danielsville & Carnesville.—Projected, Smithsonia to Danielsville, 3 miles. Jas. M. Smith, Smithsonia.

66. Thomasville Southern.—Surveyed, Thomasville to Tallahassee, 35 miles. Ch. Engr., J. S. Montgomery, Thomasville.

67. Warsaw & Cumming.—Projected, Norcross to Cumming, 20 miles. Ch. Engr., Henry Allen, Warsaw.

Total.—Track laid in 1891, 230.5 miles. Track laid since Jan. 1, 1892, 40.5 miles. In process of construction, 49 miles. Surveyed or under survey, 802 miles. Projects of some promise, 573 miles.

Florida.—Existing Roads.

68. Arcadia, Gulf Coast & Lakeland.—Track laid since Jan. 1, 1892, Braidentown to Sarasota, 13 miles. Located, Lakeland to Bradentown, 67 miles. Projected, Keysville to Charlotte Harbor, 110 miles. Pres., Anthony Peters, 88 Lincoln St., Boston, Mass.; Ch. Engr., K. B. Harvey, Punta Gorda.

70. Florida Central & Peninsula.—Track laid in 1891, Archer to Early Bird mines, 28.7 miles; branches to Phosphate mines, 6 miles. Track laid since Jan. 1, 1892, Turkey Creek to Lighthall's phosphate mines, 5.1 miles. Ch. Engr., B. Burwell, Jr., Jacksonville.

71. Florida, Georgia & Western.—Track laid in 1891, Tallahassee to Lake Como, 11 miles. Partly graded, Lake Como to the Aucilla River, 31 miles. Projected, Aucilla River to Old Town, 60 miles. Ch. Engr., F. P. Damon, Tallahassee.

72. Gainesville, Rocky Point & Micanopy.—Partly graded, Gainesville to Micanopy, 12 miles. (Work suspended.) Pres., J. W. Carter; Ch. Engr., P. F. Jenkins; both of Gainesville.

73. Jacksonville, Mayport & Pablo.—Track laid since Jan. 1, 1892, Arlington to South Jacksonville, 5 miles.

74. Jacksonville, St. Augustine & Halifax River.—Under survey, Daytona to New Smyrna, 16 miles.

75. Orlando & Winter Park.—Surveyed, Oviedo to Rock Ledge, 43 miles.

76. St. Cloud Sugar Belt.—Surveyed, Narcosse to Orlando, 24 miles.

77. Silver Springs, Ocala & Gulf.—Track laid in 1891, Dunnellon to Inverness, 18 miles. Located, Inverness to Anclote, 52 miles.

78. South Florida.—Track laid in 1891, branch to Phosphoria, 7.5 miles; Pemberton Ferry north, 3 miles. Track laid since Jan 1, 1892, 3 miles north of Pemberton Ferry to Inverness, 17 miles. Surveyed, Inverness to Dunnellon, 20 miles. Ch. Engr., T. L. Morton, Sanford.

79. Starke & Sampson City.—Track laid since Jan. 1, 1892, Starke to Sampson City, 7 miles. Ch. Engr., R. F. Emsey, Starke.

80. Suwannee River.—Track laid in 1891, Louisville southeast, 3.5 miles.

Projects and Surveys.

82. Bartow & Plant City.—Surveyed, Bartow to Plant City, 19.25 miles. Pres., J. N. Tatum; Ch. Engr., Jas. L. Johnson; both of Bartow.

69. Carabelle, Tallahassee & Georgia.—Under contract, Carabelle to Sopchoppy, 20 miles. Surveyed, Sopchoppy to Thomasville, 55 miles. Ch. Engr., John M. Cooke, Tallahassee.

83. Florida Midland & Georgia.—Surveyed, Valdosta Ga., to Deadman's Bay, 85 miles. Pres., J. M. Wilkinson; Secy., W. S. West; both of Valdosta, Ga.

84. Gainesville, La Crosse & Lake Butler.—Projected, Gainesville to Lake Butler, 27 miles. Pres., I. E. Webster, Gainesville.

85. Halifax & Indian River.—Surveyed, Daytona to Titusville, 45.6 miles. Robbins & Graham, Titusville.

86. Ocala, Altoona, DeLande & New Smyrna.—Projected, Ocala to New Smyrna, 75 miles. F. J. Hinson, Astor.

87. Suwanee & Gulf.—Surveyed, Bronson to Lura-ville, 52 miles. Ch. Engr., Chas. P. Turner, Atlanta, Ga.

88. Tavaris, Atlantic & Tampa.—Projected, New Smyrna to Tampa, 125 miles. Ch. Engr., Geo. O. Butler, Tavaris.

81. Winnston & Bone Valley.—Under construction, Winnston to Phosphoria, 11 miles. Pres., J. E. Griffith, Winnston.

Total.—Track laid in1891, 77.7 miles. Track laid since Jan. 1, 1892, 47.1 miles. In process of construction, 74 miles. Surveyed or under survey, 529 miles. Projects of some promise, 407 miles.

Alabama.—Existing Roads.

89. Alabama Grand Trunk.—Graded, Montgomery to the Tallapoosa River, 11 miles. Surveyed, Tallapoosa River to Wetumpka, 5 miles. Pres., H. G. McCall; Ch. Engr., C. P. Rogers; both of Montgomery.

90. Birmingham & Jones Valley.—Partly graded, Avondale to Springville, 25 miles. Surveyed, Springville to Gadsden, 40 miles. Ch. Engr., Carl O. Lagerfelt, Birmingham.

91. Birmingham, Sheffield & Tennessee River.—Surveyed, Margerum to Riverton, 25 miles; Parrish to Birmingham, 46 miles. Ch. Engr., A. Mitchell, Sheffield.

Blue Mt. Mineral.—Track laid in 1891, Tredgar Junction to Jacksonville, 3 miles.

92. Central R. R. of Georgia.—Track laid in 1891, Troy to Andalusia, 51 miles.

45. Chattanooga Southern.—Track laid in 1891, Georgia line to 12 miles north of Gadsden, 40 miles.

93. Decatur, Chesapeake & New Orleans.—Partly graded, between Decatur and the Tennessee line, 18 miles. (Work suspended.) Ch. Engr., W. H. Calhoun, Fayetteville, Tenn.

94. Escambia.—Surveyed, Steadham to Little River, 7 miles. Pres., M. H. Sullivan, Flomaton.

95. Florence Northern.—Partly graded, Florence north, 27 miles. (Work suspended.) Ch. Engr., A. G. Negley, Florence.

96. Gulf & Chicago.—Surveyed, Cedar Point to Tuscaloosa, 229 miles. Ch. Engr., L. H. Clarke, Mobile.

97. Gurley's & Paint Rock Valley.—Track laid since Jan. 1, 1892, Gurley's up the Paint Rock Valley, 5 miles. Under construction, Winchester to Deposit, 75 miles. Projected, Deposit to Guntersville, 6 miles; Deposit to Oneonta, 34 miles. Ch. Engr., Samuel J. Wheatcroft, Gurley's.

98. Isbell & Iron Mt.—Graded, Isbell to Iron Mt., 5.25 miles. Pres., C. H. Castle; Secy., W. H. Nance; both of Isbell.

99. Montgomery, Tuscaloosa & Memphis.—Partly graded, Montgomery to Tuscaloosa, 107 miles. (Work suspended.) Ch. Engr., C. M. Craig, Montgomery.

100. Nashville, Chattanooga & St. Louis.—Under construction, Wyeth City to Tennessee River, 3.1 miles; branch to coal mines, 0.75 miles. Under survey, Huntsville to Hobb's Island, 10 miles.

101. Piedmont, Laney & Birmingham.—Track laid in 1891, Burnesville to Laney's mines, 1 mile; branch to Lyon's mines, 1½ miles. Projected, Lyon's mines to Piedmont, 13 miles. T. S. McDaniel, Irondale.

56. Savannah, Americus & Montgomery.—Track laid in 1891, between Montgomery and the Chattahoochee River, 60 miles.

100. Tennessee & Coosa.—Track laid in 1891, extension to Guntersville, 4.24 miles. See Nashville, Chattanooga & St. Louis R. R.

102. Tennessee River, Asheville & Coosa.—Located, Asheville to the Coosa River, 10 miles.

103. Tredgar Mineral.—Track laid in 1891, Jacksonville north, 3 miles. Track laid since Jan 1, 1892, in city of Jacksonville, 1 mile. Surveyed, Tredgar Junction to Iron Mt., 6.5 miles. Ch. Engr., Geo. H. Montgomery, Jacksonville.

Projects and Surveys.

104. Birmingham, Columbus City & St. Louis.—Projected, Guntersville to Scottsboro, 30 miles. Pres., W. E. Baskett, Chattanooga, Tenn.

104½. Columbus, Tuscaloosa & Atlantic.—Surveyed, Pickinsville to Columbus, Miss., 20 miles. Pres., C. E. Rodenberg; Ch. Engr., C. W. Mills; both of Columbus.

105. Geneva, Florala & Pensacola.—Under survey, Geneva to Pensacola, Fla., 100 miles. Pres., W. C. McLaughlin, Geneva; V-Pres., W. B. Gilmer, Florala.

106. Georgia, Tennessee & Illinois.—Surveyed, Tallapoosa, Ga., to Stevenson, 125 miles. Ch. Engr., L. F. Bellinger, Tuscaloosa & Florence.—Surveyed, Mobile to Florence, 351.4 miles. Ch. Engr., John A. Milner, Birmingham.

Tuscaloosa Coal & Iron.—Projected, Tuscaloosa to coal fields, 17 miles.

Total.—Track laid in 1891, 163.7 miles. Track laid since Jan 1, 1892, 6 miles. In process of construction, 289 miles. Surveyed or under survey, 1,189 miles. Projects of some promise, 114 miles.

Mississippi.—Existing Roads.

108. Gulf & Ship Island.—Surveyed, extension to Hattiesburg, 51 miles. Ch. Engr., W. W. Hungerford, Gulfport.

109. Illinois Central.—Surveyed, Parsons to Grenada, 18 miles.

Projects and Surveys.

110. Memphis & Atlantic.—Surveyed, West Point to Houston, 30 miles.

111. Mobile, Jackson & Kansas City.—Located, Mobile, Ala., to Brandon, 184 miles. Ch. Engr., T. W. Nicol, Mobile, Ala.

Total.—Surveyed or under survey, 258 miles.

Tennessee.—Existing Roads.

3. Bristol Belt.—Track laid in 1891, at Bristol, Tenn., 5 miles. Surveyed, Bristol to Blountville, 11 miles. Gen. Man., W. A. Stadleman, Bristol.

112. Bristol, Elizabethtown & North Carolina.—Track laid in 1891, at Bristol, 1 mile. Graded, Bristol to Elizabethtown, 20 miles. Surveyed, Elizabethtown to Mountain City, 40 miles. Surveyed, Elizabethtown to Irwin, 18 miles. Ch. Engr., Geo. S. Bruce, Bristol.

93. Decatur, Chesapeake & New Orleans.—Partly graded, Lincoln Co. line to near Shelbyville, 13 miles. (Work suspended.) See Alabama.

113. East Tennessee, Virginia & Georgia.—Track laid in 1891, Dorr's Mill toward Embreville, 11 miles.

114. Harriman Coal & Iron.—Track laid in 1891, at Harrimann, Tenn., 1.25 miles. Tracklaying in progress, Harriman to Brushy Mt., 14 miles. Engr. in Charge, J. F. Simpson, Harriman.

5. Louisville & Nashville.—Track laid in 1891, Pond Station to Van Leer, 11 miles; Hematite to Marion, 14 miles; Van Leer to Cumberland furnace, 6 miles; Louise to Van Leer, 7.1 miles. Engr. in Charge, C. A. Bradford, Louisville.

115. Middle & East Tennessee.—Track laid in 1891, extension to Hartsville, 5 miles. Surveyed, Hartsville to Carthage, 15 miles.

116. Middlesborough Belt.—Track laid in 1891, Bennett's Fork branch, 0.77 mile.

117. Morristown & Cumberland Gap.—Track laid in 1891, Morristown to Corryton, 44 miles.

118. Nashville & Knoxville.—Track laid in 1891, Cookeville to Algood, 5 miles. Under construction, Algood to Standing Stone, 11 miles. Projected, Standing Stone to Glen Mary, 45 miles. Ch. Engr., R. J. Moscrip, Cookeville.

119. Paducah, Tennessee & Alabama.—Track laid in 1891, Hazel to Hallow Rock, 38.6 miles. Surveyed, Hallow Rock to Lexington, 28.9 miles. Projected, to Florence, Ala., 90 miles. Ch. Engr., N. R. Olcott, Paducah, Ky.

120. St. Louis & Birmingham.—Under construction, Clifton to Florence, Ala., 65 miles. Ch. Engr., L. S. Proctor; Gen. Man., J. R. Johnson; both of Clifton.

119. Tennessee Midland.—Track laid in 1891, at Memphis, 2.5 miles. Surveyed, Perryville to Nashville, 92 miles. Now a part of the Paducah, Tennessee & Alabama R. R.

121. Watauga Valley.—Track laid in 1891, Watauga toward Watauga Point, 1.1 miles. Under construction, extension to Watauga Point, 3.9 miles. Ch. Engr., J. R. Englebert, South Watauga.

Projects and Surveys.

122. Missouri, East Tennessee & Virginia Air Line.—Projected, Memphis to Bristol, Tenn., with branches to Fulton, Ky., and Elora, Tenn., 685 miles. Pres., Geo. M. Buttrick, Boston, Mass.; Ch. Engr., L. E. Wolkins, 258 Washington St., Boston.

123. Shelbyville, Nashville & Northern.—Surveyed, Shelbyville to Nashville, 54 miles. Pres., G. C. Sandusky, Shelbyville; Ch. Engr., Wm. B. Ross, Nashville.

124. Tennessee Central.—Projected, Trenton to Milan, 10 miles.

125. Unaka & Nola Chucky.—Surveyed, Erwin to Newport, 55 miles. Pres., A. S. Johnson; Ch. Engr., R. A. Bowie; both of Greenville.

Total.—Track laid in 1891, 147.5 miles. In process of construction, 132 miles. Surveyed or under survey, 324 miles. Projects of some promise, 815 miles.

Kentucky.—Existing Roads.

178. Cincinnati & Kentucky Southern.—Surveyed, Yosemite to Danville, 16 miles. H. D. Emerson, Cincinnati, O.

179. Kentucky Midland.—Surveyed, Paris to Morgan Co. line, 75 miles.

180. Kentucky Union.—Track laid in 1891, Katowa to Inverness, 3 miles.

Middlesborough Belt.—Track laid in 1891, branch up Stony Fork near Middlesborough, 3.96 miles.

181. Ohio & Big Sandy.—Track laid in 1891, Richardson toward Big Sandy Bridge, 14 miles. Track laid since Jan. 1, 1892, 14th mile to Big Sandy Bridge, 2 miles.

Ohio Valley.—Track laid since Jan 1, 1892, Gracey east, 4 miles. Under construction, extension to Hopkinsville, 6 miles.

182. Owensboro, Falls of Rough & Green River.—Under Survey, Fordsville to Caneyville, 20 miles.

183. Richmond, Nicholasville, Irvine & Beattyville.—Track laid in 1891, Richmond to Irvine, 22 miles. Partly graded, Irvine to Beatiyville, 35 miles. (Work suspended.)

Projects and Surveys.

127. Altamont & Manchester.—Surveyed, Altamont to Manchester, 20 miles. Pres., C. Crooke, Altamont.

128. Bowling Green & Northern.—Surveyed, Grayson's Springs Station to Scottville, 75 miles. Secy., M. H. Crump, Bowling Green.

129. Chicago, Evansville & Chattanooga.—Located, Evansville, Ind., to Bowling Green, 100 miles. Pres., S. K. Sneed, Henderson; Ch. Engr., A. B. Fitch, Terre Haute, Ind.

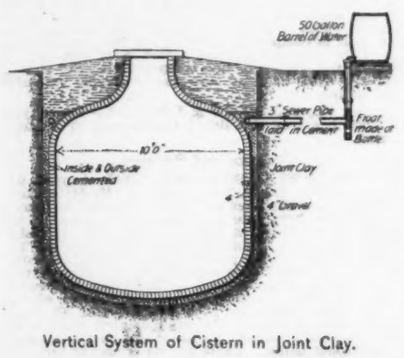
130. Cincinnati & Kentucky Southern.—Surveyed, Yosemite to Danville, 16 miles. H. D. Emerson, Cincinnati.

Fordsville, Hartford & Southwestern.—Projected, Fordsville to Hartford, 24 miles. Pres., Thos. J. Smith; Ch. Engr., John J. McHenry; both of Hartford.

Total.—Track laid in 1891, 42.96 miles. Track laid since Jan. 1, 1892, 6 miles. In process of construction, 41 miles. Surveyed or under survey, 322 miles. Projects of some promise, 24 miles.

BUILDING A CISTERN IN JOINT CLAY.

The material known as joint clay occurs throughout extended sections of the West. In recent geologic times the territory north of the Ohio and Missouri rivers was covered with glaciers. As these melted and receded they left extensive deposits of clays, especially along what had been their southern border. These clays are generally stiff and for the most part are impervious to water. When exposed to the air or when penetrated by wells, however,



Vertical System of Cistern in Joint Clay.

they shrink and crack and are called joint clays. Another material to which the same name is given is the black sticky clay, sometimes called gumbo, which occurs on river bottoms.

The following scheme for building a cistern in joint clay is sent us by Mr. Gordon Dinsmoor, of Columbia, Mo., and may be of service to some of our readers. Mr. Dinsmoor says:

All attempts to make a satisfactory cistern in joint-clay have hitherto failed. If such a cistern be lined with a dry wall of brick, it will hold water very well; but since the calcium carbonate in the soil soon renders the water hard, such a reservoir loses its value as a cistern.

If, on the other hand, the wall be laid in cement, and cemented inside and out, it will hold water until the joint-clay dries and shrinks away from the wall, then the inside pressure breaks the wall and the water leaks out.

The accompanying design for a cistern in joint-clay is intended to overcome these difficulties:

A 4-in. space is left between the joint-clay and the brick, so as to give room to plaster the outside of wall with cement as it is carried up. After building a foot or more, this space is filled with gravel, and so on up to the line (A B), when a circle of 3-in. drain tile is laid, connecting with a line of sewer pipe laid in cement, which is turned up and brought to the surface as shown in plan. Water is now poured into the open end of the sewer pipe until all the interstices of the gravel are filled, thus causing a constant pressure upon the outside of the wall. The joint-clay, being impervious, holds this water so that little is lost by percolation.

A constant level of water in the gravel is maintained by the flow from a barrel, the outlet of which is automatically opened and closed by a float, as shown in the plan. The only attention needed is to see that the barrel does not become empty.

TRESTLE WASHOUT ON THE CHICAGO, MILWAUKEE & ST. PAUL RY.

The accompanying cut shows the result of a washout caused by the May floods north of Hawarden, Ia., on the Chicago, Milwaukee & St. Paul R. R. The trestle was intended to furnish an open water course for a narrow stream, called Dry Creek, because it was dry in the summer time. On May 19 the flood had washed away the embankment on each side, as shown, making about 300 ft. from bank to bank, only the rails and ties remaining to indicate where the bank had been. The railway company quickly repaired the damage when the water had subsided. We are indebted to Mr. John T. Price, C. E., of Chicago, for particulars and photograph of this washout.

WASHOUT ON THE CHICAGO, MILWAUKEE & ST. PAUL RY., NEAR HAWARDEN, IA.

Surveys are in progress for obtaining data from which to compile a detailed map of Fayette Co., Md., showing land lines, railways, water-courses, and county roads. Work was commenced May 10, and the map is expected to be placed in the hands of the lithographers by November. Mr. L. W. Atkinson, Cotton Hill, W. Va., is Chief Engineer.

The Vienna Tramway Co. intends to introduce the zone-tariff on its lines. The whole district traversed by tramways in that city is to be divided into three zones. The fare for one zone is to be 2½ cts., for two zones 3¾ cts., nearly, and for three zones 5 cts. On Sundays and holidays a uniform fare of 5 cts. is to be collected without regard to the distance traveled. The project to run separate "workmen's cars" at 6 a.m. and 6.30 p.m. from the terminal points to the "Ringstrasse" (center of the city), and vice versa, on which a uniform fare of 2 cents. is to be collected, is also under consideration. The present European practice is to vary fares by a cent or two, according to distance, but the American fashion of uniform fares is likely to come in in time.

Wood carvings produced by hydraulic pressure are described in the "Civil Techniker" as follows:

Wood of any description, after being prepared in a simple manner, is subjected to hydraulic pressure by which process its structure is entirely changed and its fibers so compressed that it attains the hardness of iron. In this way carvings can be reproduced. Wood carvings by this process are now being manufactured at Schlan, near Prague, Bohemia.

ELEMENTS OF WEATHER IN THE UNITED STATES OF MOST INTEREST TO ENGINEERS FOR THE MONTH OF MAY, 1892.

[Furnished to Engineering News by the Department of Agriculture.]

	Station.	Temperature. (Deg. Fahr.)				Wind.			Precipitation—(Rain and melted snow)—inches.		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average	Max.	Min.	Range.	Average	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	49.6	80	24	56	9.6	40	W	3.30	1.02	18
	Portland, Me.	51.4	77	32	45	9.6	29	N	4.41	1.35	15
	New York City	59.4	81	42	39	10.6	35	NW	4.30	0.85	16
	Pittsburg, Pa.	...	...	...	...	...	...	...	...	...	...
	Chicago, Ill.	52.4	76	37	39	18.0	60	SW	6.77	1.66	17
	Omaha, Neb.	54.2	78	37	41	10.5	38	N	8.43	2.80	18
	St. Paul, Minn.	50.8	72	30	42	8.8	36	NW	5.17	1.39	21
	Duluth, Minn.	44.4	72	32	40	8.6	36	N	6.54	2.02	16
	Bismarck, N. Dak.	40.3	76	24	52	11.4	48	NW	1.79	0.85	12
	Average	51.1	76.5	32.2	44.2	10.9	40.2	...	5.09	1.49	17
Southern Cities.	Washington City	63.8	89	44	45	7.1	42	NW	4.07	2.04	13
	Louisville, Ky.	64.7	88	45	43	9.5	37	W	4.44	0.89	17
	St. Louis, Mo.	62.8	87	40	47	12.4	47	W	7.87	1.76	5
	Savannah, Ga.	72.8	91	51	40	8.9	27	E	2.17	1.51	6
	Leavenworth, Kan.	59.0	82	38	44	11.1	48	NW	8.66	1.92	20
	Jacksonville, Fla.	75.2	92	52	40	7.9	30	SW	1.34	0.61	5
	Chattanooga, Tenn.	68.2	90	44	46	5.4	30	NE	3.29	1.25	14
	New Orleans, La.	74.0	88	55	33	9.7	45	N	2.62	1.35	9
	Memphis, Tenn.	68.6	86	48	38	8.1	36	NW	7.46	2.69	15
	Palestine, Tex.	72.3	91	43	48	8.3	25	SE	4.18	2.21	9
	Average	68.1	88.4	46.0	42.4	8.8	36.7	...	4.61	1.62	12
Western Cities.	Helena, Mont.	47.7	85	24	61	8.2	40	SW	1.54	0.58	13
	Port Angeles, Wash.	50.3	70	36	34	6.3	30	W	1.87	0.58	15
	San Francisco, Cal.	58.0	90	47	43	9.0	32	W	1.86	1.15	8
	Salt Lake City, Utah	55.4	85	36	49	5.3	34	SW	1.65	0.34	13
	Denver, Colo.	51.5	81	32	49	8.8	40	N	2.14	0.63	15
	Yuma, Ariz.	76.7	110	47	63	8.2	32	NW	0.05	0.05	1
	Santa Fé, N. Mex.	55.0	76	32	44	9.2	38	SW	0.50	0.21	5
	Average	56.4	85.3	36.3	49.0	7.9	35.1	...	1.37	0.51	10

The combined pig iron production of the earth, according to "Stahl und Eisen," was in metric tons:

1888	1889	1890
23,550,000 tons	24,870,000 tons	28,152,000 tons.

To this latter amount the different countries contributed as follows:

	Tons.
United States	9,348,000
Great Britain	8,030,000
Germany	4,658,000
France	1,970,000
Austria-Hungary	946,000
Belgium (1889)	832,000
Russia	746,000
Sweden (1889)	421,000
Servia	152,000
Canada	28,000
Italy	13,000
Norway, Switzerland, Australia and Japan Combined	10,000
Total	28,152,000

Germany's pig iron production for the years mentioned, was:

1888	1889	1890
4,337,000 tons.	4,525,000 tons.	4,658,000 tons.

This latter amount is made up by:

	Tons.
Puddled pig iron	2,029,000
Bessemer "	430,000
Thomas "	1,556,000
Foundry "	560,000

A remarkably quick electric installation for lighting a new church at White Plains was accomplished last week by H. Ward Leonard & Co., of this city. The local electric light company had agreed to have the church lighted in time for the consecration services, but having failed to do so in time, the above named firm was asked at 4:30 p. m. if it would be possible to secure, deliver at White Plains, and install a dynamo, complete the wiring, run the line to the central station plant, alter the speed of the engine, supply belting, etc., all in time to have the plant running at 10:30 a. m. the next day. The contract was accepted and the plant was in successful operation at 10:13 a. m.

The new Chicago 14th St. pumping station was opened on June 8. It is built of pressed brick with stone trimmings, and is 167×17 ft. It contains three high pressure, triple expansion engines of 12,000,000 gallons

daily capacity each, manufactured by E. P. Allis & Co., of Milwaukee, Wis. Each engine weighs 500 tons and measures 83 ft. from the top of the cylinders to the pump foundation. The cylinders are 27 ins. in diameter, 60-in. stroke. The intermediate cylinders are 70 ins. in diameter, 60-in. stroke. Each cylinder drives 32 and 34 in. plunger, 60-in. stroke. There are two fly wheels on each engine weighing 35 tons, 25 ft. in diameter. Steam is furnished by nine tubular boilers, 20 ft. long and 62 ins. in diameter, with 49 4-in. tubes in each boiler. When the station is working at its full capacity, six of the boilers will be used for operating the engines and the other three will be at rest while being cleaned. Space has been left for four more boilers, and in the engine room space has been set apart for a 20,000,000 gallon engine.

The station gets its water now from the old 7-ft. tunnel running from the East Chicago Ave. station to 22nd St. The tunnel is tapped for the supply at Van Buren and Jefferson Sts., and at the Harrison St. works. The pipes run from the latter works and from Van Buren and Jefferson Sts., along Jefferson and Harrison Sts., the two uniting at Jefferson and Harrison, and running thence along Harrison to Peck court, where a turn is made to Indiana Ave., along which the pipe runs to the 14th St. station.

The Barney & Smith Car Co. has been organized to acquire the plant and carry on the business of the Barney & Smith Mfg. Co., of Dayton, O., whose business was established in 1849, and which has been engaged in the manufacture of passenger, parlor, sleeping, dining, freight, coal, refrigerator, and other cars, and car wheels and castings. The plant covers 28 acres of ground, and includes 40 buildings, mostly of brick and stone. The company employs 1,750 men. The new company has a share capital of $3,500,000. President, E. J. Barney; Vice-President, J. D. Platt; Secretary, F. E. Smith; Superintendent, A. M. Kittredge.

An electric safety block system for railways, which is controlled by the Strohm Automatic Electric Safety Block System Co., of Philadelphia, was tried June 16 on 2½ miles of the Brooklyn & Brighton Ry. The current generated by a small dynamo in the engine cab is grounded by contact plates in the track at the end of each block, when the signals are at danger, causing an armature to drop, which opens a steam pipe by means of which steam is shut off, the brakes applied and the whistle sounded. Should a second train enter a block before the first has passed onto the next block, it would be brought to a stop.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

BUFFALO, ROCHESTER & PITTSBURG.—Wm. E. Hoyt, Ch. Engr., Rochester, Pa., writes us that the Clearfield & Mahoning R. R. Co., whose incorporation was noted in our issue of June 9, proposes to build a railway from Clearfield, Pa., via Curwensville, Bridgeport and Luthersburg to Jefferson Line, on the Buffalo, Rochester & Pittsburg R. R., a distance of about 27 miles. The route is through a mountainous country and the work will be heavy, there being a large amount of rock work. The grades and curves will be easy. There will be three large spans of iron or steel bridge over the Susquehanna River and a long steel viaduct at Curwensville, Pa. The principal business of the road will be the coal traffic. It is stated that the line will ship 500,000 tons of coal annually from the Rochester & Pittsburg Coal & Iron Co., and the Beil, Lewis & Yates Coal Mining Co. About 600 men are now at work on the line. The contractors are, Geo. S. Goode & Co., Clearfield, Pa., John Shields, Flemington, N. J., Thos. Collins, Havana, N. Y., and Calvin E. Broadhead, Caledonia, N. Y. It is expected to begin tracklaying in November and to have the line completed this year.

PHILADELPHIA & READING.—An extension of the Schuylkill Valley R. R. from Spring City to Rojer's Ford, Pa., one mile, is to be built. It is stated that the line will cost $110,000 and will include a considerable viaduct and bridge work.

PORTLAND & RUMFORD FALLS.—This line from Gilbertsville to Rumford Falls, Me., 14 2-5 miles, has been completed and will be soon opened for traffic.

KINGSTON, NAPANEE & WESTERN.—It is stated that work will soon begin on the proposed extension form Harrowsmith to Lake Lydenham, Ont., 10 miles.

BROOKLINE & PEPPERILL.—This line from West Groton, Mass., to Brookline, N. H., 14 miles, has been completed. It is stated that the Fitchburg R. R. Co., will operate the road.

OREGON & TEXAS.—This company has been chartered in Pennsylvania to build a railway from Cammel to Silver Spring, Pa. This road which has been referred to under the head of Cammel & English Center, is now under construction. Pres., Chas. E. Titman, Shenandoah, Pa.

IRON RANGE & HURON BAY.—It is stated that tracklaying will be commenced on this railway from Champion, Mich., to Huron Bay, 35 miles, about July. Gen. Supt., Sanford Keeler, Arvon, Mich.

ROCKAWAY VALLEY.—A force of 100 men are now grading the extension of this railway to Morristown, N. J. It is expected to have the line open for traffic by September.

Projects and Surveys.

CHARLEROI & BELLE VERNON.—Chartered in Pennsylvania to build a railway from Charleroi to a point near Belle Vernon, Pa., 3 miles. Pres., Wm. D. Hortupee, Charleroi, Pa.

FAIR HILL.—Chartered in Pennsylvania to build a railway from Hart's Lane, in Ward 33, Philadelphia, Pa., to Cambria St. Pres., J. N. Du Barry, Philadelphia.

MANCELONA & NORTHWESTERN.—This company has been chartered in Michigan to build a railway from Mancelona to Cedar River Valley, Mich.

CAMDEN & LEWISTON.—It is stated that a preliminary survey will soon be made for a railway from Camden to Lewiston, Me., via Augusta, Me.

PERE MARQUETTE & BIG RAPIDS.—Chartered in Michigan to build a railway from Ludington to Big Rapids, Mich. The principal office will be at Ludington, Mich.

PHILADELPHIA & CAPE MAY.—Papers are being circulated for subscriptions to the stock of this company, which proposes to build a railway from Philadelphia to Cape May, N. J.

COLLEGE HILL MARGINAL.—Chartered in Pennsylvania to build a railway from Beaver Falls, Pa., to College Hill and thence to a connection with the Pittsburg & Lake Erie R. R.

SLACK WATER CONNECTING.—Chartered in Pennsylvania to build a railway from the Monongahela River to a connection with the Pittsburg & Connellsville R. R. Pres., Henry C. Fownes, Pittsburg, Pa.

CLERMONT & MARVIN CREEK.—This company has been chartered in Pennsylvania to build a railway from Clermont, McKean Co., Pa., to Marvin Creek. Pres., Thos. C. Wainman, Eldred, Pa.

BINGHAMTON & STATE LINE.—At a meeting of the directors of this company held on June 18, the following officers were elected: Pres., Joseph P. Noyes; Vice-Pres., W. Scott Brandt; Secy., E. E. Katteil, and Treas., H. C. Ross.

ST. LAWRENCE.—This company, whose incorporation in New York was noted in our issue of March 26, will make an application to the Quebec Legislature at its next session for a charter to build the portion of the proposed line in Canada.

OSCEOLA LAKE & WEXFORD.—A correspondent writes us that the surveys have been completed for the proposed extension of the 10-mile railway operated by the Chittenden Lumber Co. The probable length of the extension will be 20 miles. There will be a bridge 250 ft. long and 24 ft. high. C. C. Chittenden, Cadillac, Mich.

YORK SPRINGS & DILLSBURG.—Chartered in Pennsylvania to build a railway from York Springs to Dillsburg, Pa. Pres., Thos. G. Neely, York Springs, Pa.

KISHOCOQUILLOS VALLEY.—Chartered in Pennsylvania to build a railway from Reedsville to Bellsville, Pa. Pres., Sam. Watts, Bellsville, Pa.

BANGOR & AROOSTOOK.—The contract for building two short sections of this road, one 10 miles long west from Houlton, Me., and the other 5 miles long east from Brownsville, Me., have been let and it is stated that work will soon begin. It is stated that the work for the entire line will be let in short sections. Ch. Engr., Moses Burpee, Houlton, Me.

Southern.—Existing Roads.

PADUCAH, TENNESSEE & ALABAMA.—At a meeting of the stockholders held on June 15, it was voted to extend this road at once from Hollow Rock, Tenn., to a connection with the Tennessee Midland R. R., at or near Lexington, Tenn. The contract to build the proposed extension was awarded to the Tennessee River Construction Co., the work to be completed by Jan. 1, 1893.

WINCHESTER & BEATTYVILLE.—Bids have been received for the construction of a line from Beattyville, Ky., to a connection with the Kentucky Union R. R., near Lumber Point, about 7 miles. Ch. Engr., J. H. Pearson, Beattyville, Ky. Pres., Robert Wallace, Versailles, Ky.

Projects and Surveys.

TENNESSEE.—A press dispatch from Bristol, Tenn., dated June 9: "A railroad mass meeting was held today at the new co-operative town 22 miles from here, in which many people from Asheville, Bristol, Elizabethtown and various points in Tennessee and the Carolinas participated. The object was to lay plans for the construction of a road from Asheville, N. C., to Elizabethtown, where it will connect with the Bristol, Elizabethtown & North Carolina road. By constructing this road the distance from Asheville to the North via the Norfolk & Western and the South Atlantic & Ohio would be greatly shortened. It is about 190 miles from here to Asheville via Morristown. The distance via the new route will be shortened at least 100 miles. The parties who held this meeting think also of extending the road on to the sea coast, thereby making a great competing trunk line. It will be built to Asheville at an early day. A large force of hands is now at work on the Bristol, Elizabethtown & North Carolina R. R. Trains will be running from here to the iron mines in less than two months."

Northwest.—Existing Roads.

CENTRALIA & CHESTER.—Work has been commenced on the extension of this railway from Nashville to Centralia, Ill.

CHICAGO & OHIO RIVER.—Press dispatches state that arrangements have just been completed to extend this company's line from Sidell to Chicago, Ill.

MANITOBA & NORTHWESTERN.—A press dispatch says: "There are very strong reasons for believing that the M. & N. W. Ry. will be extended to Prince Albert this season. The Dominion Government is considering the advisability of placing this road on a similar subsidy basis as the Qu'Appelle, Long Lake & Saskatchewan Ry. Urgent requests have been sent to the Minister of Railways by the people along the route, who now number about 3,000. They are being assisted in every way by Mr. MacDowall, M. P., and other Western members. If the Government accedes it is understood that the Ross-Mackenzie company will at once begin construction, probably at both ends of the work."

YANKTON, NORFOLK & SOUTHWESTERN.—It is stated that the contract for building 30 miles of this road, from Yankton, N. D., to Norfolk, Neb., has been let to M. W. Larson & Co.

NEBRASKA CENTRAL.—A press dispatch says: Omaha, Neb., has voted $750,000 in bonds to aid the Nebraska Central R. R. Co. to build a bridge across the Missouri River, a union station in Omaha and 100 miles of the railway north from Council Bluffs. The object is to give all Eastern roads a chance to enter Omaha on reasonable terms and thus to break down the embargo imposed by the Union Pacific bridge.

Projects and Surveys.

PEORIA BELT.—A company at the head of which is E. S. Easton and Benj. Warren, of Peoria, Ill., has been formed to build a line of railway about that city. The right of way has all been secured.

Southwest.—Existing Roads.

KANSAS CITY, FT. SMITH & SOUTHERN.—It is stated that the Missouri Coal & Construction Co. is making arrangements to extend this railway from Hume, Mo., to Pittsburg, Kan., 55 miles.

Projects and Surveys.

KANSAS CITY & NEW ORLEANS.—This company has been chartered in Texas by W. S. Disborough, of Dallas; Hugh Stewart, of Dalby Springs; G. W. Williams and others. The company proposes to build a railway from Clarksville via Atlanta to a point on the State line, with branches from Dalby Springs to De Kalb, and from the State line to Texarkana, a total mileage of 120. The capital stock is $200,000.

Rocky Mt. and Pacific.—Existing Roads.

GREAT NORTHERN.—About 2,600 men are now at work on the western end of the Pacific extension between Puget Sound and the summit of the Cascade Mts. The grading is nearly completed between Snohomish and Granite Point, Wash., 30 miles, and tracklaying will begin at Snohomish before August. The small tunnels are nearly finished on this section of the line and work will soon begin on the switchback at the summit, which will be used until the large tunnel at that point is completed. It is stated that an examination of the Portland & Puget Sound R. R. will soon be made by the officers of this company with the view of resuming work on it as soon as the Pacific extension is completed.

SANTA FE, PRESCOTT & PHOENIX.—Tracklaying will soon begin on this line from Phoenix to Ashfork, Arizona.

Projects and Surveys.

DENVER, & EL PASO SHORT LINE.—A press dispatch from Ft. Worth, Tex., says: P. H. McCrickett, formerly Chief Engineer of the Fort Worth & Denver City R. R., is here. He is at present in charge of the surveys of the Denver & El Paso Short Line, an undertaking which has behind it a powerful backing. The Colonel states that the preliminary survey of the route has been completed, the expense of the work having been assumed or guaranteed by the cities of Denver, Pueblo, Trinidad, in Colorado, and the cities of Las Vegas, White Oaks, in New Mexico, and El Paso, Texas. The length of the contemplated line is 522 miles, and the surveyors found no serious impediments to rapid construction. There are no grades of any consequence and the route surveyed is through a country free from stream of any great size. Colonel McCrickett states that the road opens up a country where transportation is imperatively demanded, and there can be no question of its immediate success. The stock owners are among the best known and wealthiest men in Colorado and New Mexico, and a committee is now in the East with a view of placing the bonds, and it has been determined to begin the work of grading next spring.

SIUSLAW & EASTERN.—The subsidy asked by this company to aid in building its line from Siuslaw Harbor to Eugene, Ore., 50 miles, has nearly all been raised.

Foreign.

MEXICO.—A survey has just been completed for a narrow gage railway from the San Felix mines, Sonora, Mexico, to Port Tobos, on the Gulf of California, about 26 miles. It is stated that a syndicate of Chicago capitalists has purchased the St. Felix mines and will build the road to give them an outlet to the coast.

MEXICAN NORTHERN PACIFIC.—The contractors, Hass, Townsend & Co., of Chicago, Ill., have started for Deming, N. Mex., to begin work on this road. The total projected length of the line and its branches is 1,200 miles.

ELECTRIC RAILWAYS.

DEDHAM, MASS.—A franchise has been granted to the Suburban Electric Ry. Co.

MOUNT VERNON, N. Y.—The North Mount Vernon Ry. Co. expects to begin construction soon, and intends to use the storage battery system of the Universal Electric Co. The Directors are, Judge I. N. Mills, Joseph S. Wood and Col. H. Henneberger.

NEWARK, N. J.—The Passaic & Newark Electric Ry. Co. will build a line 5 miles long; $100,000. Gen. Bird Spencer, Richard Morrell, W. K. Brown and August Stein, of Hoboken.

POTTSVILLE, PA.—Capitalists interested in the Philadelphia & Reading R. R. have secured control of the Schuylkill Electric Ry. Co., and will build extensions. For particulars address Mr. R. C. Luther.

ST. LOUIS, MO.—The largest contract ever made for street railway work in St. Louis has been closed, and it involves the expenditure of $2,000,000. New lines will connect the Northern, Central, Union, Cass Ave. and Citizens' St. railways into a single electric system. The lines will be operated by one 25,000 HP. plant, which will be only 2½ miles from the farthest point on any of the roads.

OURAY, COLO.—An electric railway on the trolley system is to be built to Ironton, at a cost of $800,000.

ASHLAND, WIS.—The Ashland Street Ry. & Lighting Co. will build a line; $75,000; George Hopper, J. H. Knight and G. W. Harrison.

ELEVATED RAILWAY.

PHILADELPHIA, PA.—The Northeastern Elevated Ry. Co. is reported as about to begin construction.

HORSE RAILWAYS.

NEW YORK, N. Y.—The East River, Central Park & North River Ry. Co. proposes to build a crosstown road from the East River at 54th St. to the North River at 79th St. A. B. Baldwin.

TAMPA, FLA.—The Tampa Street Ry. & Power Co. has let contracts for 31,270 cross ties, and will build 18 miles of track.

NEW ORLEANS, LA.—The franchise of the Crescent City Street Ry. Co., for 25 years from expiration of present franchise, will be sold Sept. 12. Comptroller, C. R. Kennedy.

MOUNT VERNON, IND.—A company has been organized to build a line 2 miles long, to be operated by mules. Pres., Jacob Foebel; Secy., E. Wagner. Capital, $15,000.

NEW COMPANIES.—North Plainfield Street Ry. Co., Plainfield, N. J.; $10,000; A. J. Manning, Trenton, N. J.; C. T. Hughes, Orange, N. J.; T. S Burr, Plainfield. Brighton Street Ry. Co., Brighton, N. J.; $20,000; H. K. Trask, R. D. Code, and A. R. Fithian. East End Passenger Ry. Co., Williamsport, Pa.; $12,000; Pres., J. M. Young. Fairhill Ry. Co., Philadelphia, Pa.; $100,000; J. W. Dubary, Jos. M. Crawford and W. J. Latta. Lakeside Ry. Co., Duluth, Minn.; $100,000; C. H. Graves, D. G. Cash and J. N. Currie.

HIGHWAYS.

NEW JERSEY.—Proposals for grading and macadamizing five county roads, and for repairing and maintaining other roads, will be received until July 5, by P. Bridge, Chr. of Comm. on County Roads, Paterson, N. J Specifications can be obtained of the County Engineer. The material is to be broken trap rock.

MARYLAND.—The Harford County Commissioners have appropriated a considerable sum of money to be expended in turnpiking by committees of citizens on the road between Churchville and Belair, and the work has been commenced. As an experiment a stone crusher is to be placed at a quarry near Belair, from whence the crushed stone will be hauled where needed. If it can be shown that macadamized roads can be made at less cost by having the stones broken with a crusher, even after a long haul, than by braking them by hand on the ground, it is believed the County Commissioners will provide several machines for use in parts of the county where stone roads are indispensable. The crushers are portable.

BRIDGES, TUNNELS AND CANALS.

CHELSEA, MASS.—The old bridge over Chelsea Creek, between this place and Revere, is in a dilapidated condition and will be rebuilt. Supt. of Streets Black will give details.

SPRINGFIELD, MASS.—City Engineer Walther has prepared plans for a bridge over the railway tracks on Main St. The plans provide for a single span iron bridge of 132 ft., the roadway to be 12 ft. and the bridge to be 20 ft. above the track.

WINDSOR, CONN.—The selectmen have been authorized to advertise for proposals for a new bridge to cross the Farmington River at Poquonock.

ALBANY, N. Y.—Bids will be received until June 28 for building a swing bridge over Peconic Canal, Long Island. Supt. Pub. Wks., Edward Hannan.

PATERSON, N. J.—At a recent meeting of the Board of Freeholders it was decided to build a $1,200 stone arch at Shadyside, one costing $1,000 on Central Ave., between Maywood and Hackensack, and another costing $1,000 on the same avenue near the Hackensack depot. A bridge across the Saddle River near the stone church, to cost $1,200, was ordered, and the Board reconsidered its former action in regard to the Hillsdale bridge, appropriating $2,000 for a new iron structure.

SPRINGFIELD, PA.—The Germantown & Chestnut Hill R. R. Co. proposes to erect an elevated bridge at Stenton Ave., over which it will build tracks.

CORAOPALIS, O.—The Coraopalis & Neville Island Bridge Co. has been chartered in Ohio to build a bridge over the Ohio River from Coraopalis, O., to Neville Island.

CHICAGO, ILL.—The West Side Park Commissioners have decided to build draw-bridges over the west fork of the South Branch at California Ave., and over the canal at Weston Ave.

HENNEPIN, ILL.—A special meeting has been called for purpose of voting on a proposition to borrow $6,000 to repair and rebuild the bridges destroyed by floods.

REDFIELD, S. DAK.—Proposals will be received until July 8 by the Comm'rs of Spink Co. for the construction of an iron bridge 118 ft. long across the James River.

WATER-WORKS.

New England.

MARBLEHEAD, MASS.—The town has voted to issue $25,000 of water bonds for a permanent pumping station and new mains.

MEDFIELD, MASS.—The Medfield Water Co. has been incorporated by E. V. Mitchell, C. T. Frost and others.

METHUEN, MASS.—C. H. Tenny, C. W. Mann and others have incorporated as the Methuen Water Co.

NORTH BROOKFIELD, MASS.—The contracts for a dam, reservoir and pumping station have been awarded to R. D. Shanahan, Boston, and laying mains to T. Hennessy, Jeffersonville.

READING, MASS.—Water bonds to the amount of $50,000 will be issued.

WARREN, MASS.—The committee on works has reported. Address F. E. Gleason or Engrs. Shedd & Searle, Worcester.

WILLIMANSETT, MASS.—C. L. Goodhue, Springfield, A. P. West and others have incorporated as the Willimansett Water Co.

CUMBERLAND, R. I.—The town has instructed its Council to buy water rights and land for works. The supply is now furnished by the city of Pawtucket.

Middle.

CARTHAGE, N. Y.—The people have voted $50,000 for works. It is reported that West Carthage may vote on the question of building works.

ILION, N. Y.—The Water Commissioners will receive bids until July 1 for $95,000 of 4% 20-year bonds. Secy., A. M. Russell.

MAYVILLE, N. Y.—Engr. R. H. Wilson, Saltsburg, Pa., will report on works.

MOUNT VERNON, N. Y.—The incorporation of the New York City Suburban Water Co. to supply water in Westchester Co. is reported; capital stock, $1,500,000.

SYRACUSE, N. Y.—The Water Board will advertise for bids for cast iron pipe for the conduit from Skaneateles Lake, for delivering and laying the pipe and for constructing a distributing reservoir.

TICONDEROGA, N. Y.—Flood & Sherrill, Sandy Hill, have the contract for building works.

WALDEN, N. Y.—The Pierce Artesian Well Co. has the contract for building works, including artesian wells.

ATLANTIC CITY, N. J.—It is reported that the two companies have consolidated.

WOODSTOWN, N. J.—I. S. Casain, Philadelphia, is engineer for the works for which $30,000 was recently voted.

DUQUESNE, PA.—The Duquesne Water Co. has been incorporated. Treas., J. F. Cockburn, Allegheny City, Pa.; $10,000.

DELAWARE CO., PA.—Companies supplying Clifton, Darby, Radnor, Swarthmore, Ridley Park and some other towns in this county have consolidated as the Springfield Water Co. The American Pipe Manufacturing Co., Philadelphia, is said to be behind the consolidation.

FRANKLIN, PA.—A new company, with a supply from springs by gravity, is reported as projected.

HOMESTEAD, PA.—Bids are wanted by the borough until June 25 for about 500 tons cast iron pipe f. o. b. at Homestead; also laying 23,000 ft. of 6 and 1,620 ft. of 12-in. pipe, and setting gates and hydrants. Chn. Water Com., F. Schuchman; Engr., Elmer Hough.

LANCASTER, PA.—Bids will be received by the city until June 30 for $150,000 of 4%, 5-30-year water bonds. Address, Robert Clark, Mayor.

WEST CHESTER, PA.—The Borough Council is investigating for a new supply.

PHILADELPHIA, PA.—A water filter bill has passed the Councils.

PITTSBURG, PA.—It is reported that Pittsburg and Connellsville capitalists propose to introduce a gravity supply for domestic purposes from Indian Creek, and that surveys have been made.

SHENANDOAH, PA.—The people have voted 764 to 514 in favor of increasing the debt to establish borough works. A company now furnishes the supply.

CUMBERLAND, MD.—W. E. Griffith, Secy. Water Comrs., has been instructed to correspond with engineers regarding plans for improved works.

WASHINGTON, D. C.—Bids will be received until June 30 for 100 fire and 50 street hydrants. Comrs., J. W. Douglass, J. W. Ross and Wm. T. Rossell.

Southern.

ALEXANDRIA, VA.—It is reported that two companies have been incorporated, as follows: Columbia Spring & Park Co.; $50,000; also Tunlaw Heights Water Supply Co.; $20,000.

WHEELING, W. VA.—The Water Board wishes to erect a new pumping station about a mile above the city, instead of increasing the plant at the present station, which, it is said, draws badly polluted water.

ORLANDO, FLA.—It is reported that H. W. Lentz, Williamsport, who recently bought the works, has transferred them to the Orlando Water & Sewerage Co., recently organized.

LAFAYETTE, LA.—Works are projected.

FAYETTEVILLE, TENN.—It is stated that J. A. Thompson, Murfreesboro, is arranging to build works here, and that a company with a capital stock of $50,000 has been formed.

North Central.

BRYAN, O.—The Village Council has passed an ordinance providing for works. The supply will be pumped from four 8-in. wells. The pumps will have a capacity of at least 2,000,000 gallons daily, and there will be at least eight miles of mains.

GREENVILLE, O.—Wm. Thompson, A. C. Robeson, James Landsowne and J. C. Weaver have been appointed as Board of Control in charge of establishing works. An election will be held to determine whether works shall be built.

BLOOMINGTON, IND.—The Bloomington Water-Works Co. has been incorporated. Of $50,000 of stock $49,800 is held by John F. Clark, New York, and the remainder by J. W. Shoemaker, W. N. and J. D. Showers and W. W. Wicks.

INDIANAPOLIS, IND.—The Board of Public Works has ordered the company to lay 20,000 ft. of mains.

DOWAGIAC, MICH.—E. Barlow Jewell, Water Comr., informs us that the supply will be increased. The Dowagaic Construction Co. will do the work with H. H. Porter, Engr. The supply is from 6-in. wells, 100 ft. deep.

WAUKEGAN, ILL.—The Fire and Water Committee has recommended that an engineer be employed to prepare plans for improvements, including a pumping station and 4,000,000-gallon pump, a 24-in. intake pipe, a 20×150-ft. stand-pipe and a supply main. J. B. Gavin, W. A. Melody and J. J. Page, committee.

VIROQUA, WIS.—This place, it is reported, has voted to bond itself for $12,000 to pay off an indebtedness, build a works, and improve streets.

Northwestern.

BOONE, IA.—It is said that a pump will be bought by the city.

DENISON, IA.—The Council has ordered the erection of a stand-pipe.

FORT MADISON, IA.—The Fort Madison Water & Light Co. has filed articles of incorporation, and proposes to own water, gas and electric light plants. H. P. Russell, East Orange, N. J., H. F. James, New York, C. H. Peters, Fort Madison, and others. The city is supplied by a company.

IOWA FALLS, IA.—Bids for $15,000 of water bonds will be received until July 1. City Recorder, Frank D. Peet.

SYRACUSE, NEB.—Works are talked of. Engr., A. A. Richardson, has been on the ground. A. Wait, H. N. Carpenter and O. Horne will report.

LANDER, WYO.—The Rocky Mountain Water Supply Co. has accepted a franchise from the city.

Southwestern.

VAN BUREN, ARK.—A franchise will be granted if suitable parties apply. F. L. Matlock, Cy. Clk.

CALDWELL, TEX.—The Council has appointed a committee to consider works, in response to a petition.

HUNTSVILLE, TEX.—The Council here has appointed a committee to report on building works.

PALESTINE, TEX.—The President of the Palestine Water-Works Co. wishes to put in 50 hydrants at $40 rental.

OKLAHOMA CITY, OKLA. T.—The Oklahoma Water-Works Co. proposes to put in a 2,000,000-gallon pumping plant and six miles of mains. Consult. Engr., L. Kingman, Topeka, Kan.

EDDY, N. M.—The Eddy Water-Works Co. has been incorporated by H. S. Church, W. A. Hawkins and others; $100,000.

Pacific.

ANACORTES, WASH.—F. V. Hogan has asked for a franchise. The Anacortes Water-Works Co. is operating under a franchise granted by the County Commissioners before the town was incorporated.

GARFIELD, WASH.—It is said that the prospects for works are good.

SEATTLE, WASH.—It is probable that 11,000 ft. of 6 and 5,000 ft. of 4-in iron pipe will be bought.

WEST RIVERSIDE, CAL.—The West Riverside Water Co., has been incorporated; directors, D. L. Wilbur, Geo. H. Hill and others; $200,000.

VALLEJO, CAL.—The city has voted, 695 to 329, $250,000 of bonds for city works. The supply is now furnished by a company. The project has been voted down once.

RATHDRUM, IDA.—The Rathdrum Water & Power Co. has contracted with R. A. Jones, Spokane, for works. John Russell and M. D. Wright are among the stockholders. The supply will be from the mountainside. Capital stock, $10,000.

Canada.

HALIFAX, N. S.—It is proposed to build a 350,000,000-gallon reservoir to be formed by a dam 30 ft. high and 400 ft. long; also to lay a new supply main.

FAIRVILLE, N. B.—Works are projected by the Fairville Water & Electric Light Co. Chief Engr. H. Peters is one of the provisional directors. A stand-pipe system is proposed.

LACHUTE, P. Q.—Plans for proposed town works are being made by Engr. Kennedy, Montreal, according to press dispatch

TORONTO, ONT.—It is proposed to add a 10,000,000-gallon pump.

ARTESIAN WELLS.

LOWELL, MASS.—Cy. Engr. Bowers has been instructed to prepare plans and estimates for wells to be sunk by the city.

ST. AUGUSTINE, FLA.—The Kennish Heat & Power Co. proposes to sink wells here for heat and power. Capital stock, $100,000.

BIRMINGHAM, ALA.—The County Commissioners Court think of sinking a 6-in. well at the rear of the court house to supply the court house and jail.

EL PASO, TEX.—The City Clerk has been authorized to advertise for sinking a well.

IRRIGATION.

ELLENSBURG, WASH.—It is reported that Engr., H. K. Owens, Seattle, will make surveys for a 50-mile ditch drawing water from Lake Noden to irrigate land near here.

OTAY, CAL.—The Directors of the Otay Irrigation District and Consult. Engr., J. D. Schuyler, of San Diego, have reported on proposed works. The project includes a dam 150 ft. high, storing 13,300,000,000 gallons or 490,785,000 cu. ft. of water; 42½ miles cement-line canal and 6½ miles of natural creek channels, and a distributing system. Total estimated cost, $1,500,000. An election to vote on the project will be held June 30.

COLTON, CAL.—Engr. F. C. Finkle, San Bernardino, has reported on works for the district.

NEW COMPANIES.—Saratoga Ditch Co., Saratoga, Wyo.; $16,000. Bailey Lake Ditch & Reservoir Co., Fort Collins, Colo.; Directors, C. B. Andrews, Julia H. Andrews, J. C. Abbott; $10,000. North Fork Canal Co., Denver, Colo.; $200,000; to construct canal in Delta Co. Juniata Canal & Milling Co., Pueblo, Colo.; Directors, W. P. Hobson, F. E. Forbitt and others; $125,000; water will be taken from the Huerfano River. Alta Land & Water Co., Grand Junction, Colo.; $100,000. St. Vrain Reservoir & Fish Co., Longmont; Directors, Asa D. Holt, J. H. Holmes and others. Washington Irrigation & Land Co., North Yakima, Wash.; $100,000. Silver Lake Ditch Co., Joseph, Ore.; $8,000. Grant Canal & Irrigation Co., Fresno, Cal.; Directors, E. B. and Robert Perrin, M. P. Minor and others. South Side Irrigation Co., Lemoore, Cal.; $10,000. Santa Ana Electric Power & Development Co., San Bernardino, Cal.; $1,000,000. Cache Valley Canal Co., Idaho Falls, Ida; $1,000,000.

SEWERS.

DOVER, N. H.—Bids are asked until July 5 for trenching and back-filling for about 5,600 lin. ft. of 12 to 24-in. pipe sewers, including 1,500 cu. yd. rock excavation. L. L. Gerry, Cy. Engr.

LEBANON, N. H.—A special meeting is to be held to discuss the question of a sewerage system.

BROOKLINE, MASS.—The Board of Selectmen will receive bids until June 27 for about a mile of pipe sewers.

STAMFORD, CONN.—Plans for a sewerage system have been prepared by J. P. Bogart, Bridgeport; estimated cost, $30,000 to $40,000.

WATERBURY, CONN.—Bids are asked until June 29 for about 524 lin. ft. of 18-in. vitrified pipe sewer, 395 ft. 15-in., 2,374 ft. 8-in. R. A. Cairns, Cy. Engr.

BUFFALO, N. Y.—The Department of Public Works will receive bids until July 2 for 10 to 30-in. tile sewers.

CORTLAND, N. Y.—A Board of Sewer Commissioners has been appointed. F. H. Cobb and C. W. Collins are members.

GLENS FALLS, N. Y.—Bids are asked until July 14 for about 25 miles of sewers. S. E. Babcock is Engineer. See advertisement.

NEW YORK, N. Y.—It is proposed to extend the Webster Ave. sewer from 184th St. to Bedford Park. Department of Public Works will receive bids until June 29 for five sewers.

OLEAN, N. Y.—The sewer contracts for which bids were opened June 11 have been awarded to W. H. Manderville, at $17,766 and $15,188. We are informed by Robert H. Wilson, Engr., Corry, Pa., that many laterals will be built in the near future.

FREEHOLD, N. J.—Plans and estimates for sewers on the separate system have been prepared by N. J. Canover, Freehold, and A. H. Tyson, Reading, Pa. The estimates are $24,300 and $29,285 for 7.4 and 8.8 miles, respectively, of 8 to 10-in. pipe sewers.

ALTOONA, PA.—The contract for the Ninth St. sewer has been awarded to Bowman Bros., McKeesport, at $28,000.

CARBONDALE, PA.—Bids are asked until July 2 for about 18,000 lin. ft. of pipe sewers. Walter Frick, Cy. Engr. See advertisement.

LOCK HAVEN, PA.—The proposed sewer between Sixth and Race Sts. will require 3,850 ft. of 30-in. pipe, 3,100 ft. of 20-in., and 1,900 ft. of 15-in. The head of the sewer will be 4 ft. deep and the outlet 17 ft., and about 11,611 cu. yds. of excavation will be required; approximate estimate, $13,000.

ROSEMONT, PA.—It is proposed to establish a sewer system to extend from this place to the vicinity of Berwin, to include Villa Nova, Upton, Radnor, St. Davids, Wayne, Strafford and Devon. The right of way is being secured, and it is reported that A. J. Drexel and Geo. W. Childs have pledged $50,000 toward the plan.

PORTSMOUTH, VA.—A system of sewerage will soon be constructed; estimated cost, $100,000.

KNOXVILLE, TENN.—Bids are asked until July 7 for about 2 miles of brick sewers and 47 miles of pipe sewers. M. Nicholson, Cy. Engr.

NEWPORT, KY.—Plans for the sewerage districts of the city have been completed by B. R. Morton, Cy. Engr.

CRAWFORDSVILLE, IND.—Bids are asked until June 27 for a 30-in. single ring brick sewer. Ira McConnell, Cy. Engr.

ISHPEMING, MICH.—Bids are asked until July 2 for about 22,240 lin. ft. of 8 to 36-in. sewers. M. S. Hawkins, Engr. See advertisement.

IONIA, MICH.—Bids are asked until July 1 for about 5,000 ft. of branch sewers. Fred. Cutler, Cy. Clk.

MENOMINEE, MICH.—The City Clerk will receive bids for sewers, paving and curbing Main St.

LOUISIANA, MO.—The City Council is considering the question of a sewerage system.

ST. JOSEPH, MO.—It is proposed to construct an 8-ft. sewer to cost about $10,000.

BUTTE, MONT.—The City Engineer has prepared plans for sewers and other improvements estimated to cost $146,654.

PORTLAND, ORE.—The lowest bid for the Portland Heights sewer was that of the American Bridge & Contract Co., $22,803.

LOS ANGELES, CAL.—The Council has voted in favor of the proposed outfall sewer to cost $360,000, and an election will be called to vote on the issue of bonds. It is estimated that an additional $90,000 will be required for laterals.

STREETS.

BOSTON, MASS.—Bids are asked until June 30 for paving Washington St. from Bolyston St. to Adams Sq. with granite blocks on concrete. H. H. Carter, Supt. of Sts.

PAWTUCKET, R. I.—It is proposed to improve Pine St. The estimates are macadam, $7,000; block paving, $22,000; vitrified brick, $18,500.

BUFFALO, N. Y.—The lowest bids for two contracts were those of the Barber Asphalt Co., $40,286 and $41,993. Department of Public Works will receive bids for paving on June 28 and July 1.

TROY, N. Y.—The Council has ordered the paving of two streets with asphalt and one with brick.

BELLEVILLE, N. Y.—The Board of Surveyors will receive bids for grading five streets.

WASHINGTON, D. C.—The District Commissioners will receive bids until July 1 for paving and sewer brick.

COLUMBUS, O.—The contract for paving Livingston Ave. with Hayden blocks, on stone foundation, with tar filling, has been awarded to N. B. Abbott, at $111,953

PORT CLINTON, O.—Bids are asked until July 11 for grading, draining, curbing and brick paving, for two streets. W. W. Montgomery, Clk. Council.

CRAWFORDSVILLE, IND.—Bids are asked until June 27 for grading and brick paving, two contracts. Ira McConnell, Cy. Engr.

SPRINGFIELD, ILL.—Bids are asked until June 20 for 8,000 sq. yds. of paving with brick blocks 4 × 5 × 12 ins. in size. R. D. Lawrence, Mayor.

QUINCY, ILL.—The Secretary of the Board of Public Works has been instructed to ask for bids for 11 contracts for street improvements.

SPRINGFIELD, ILL.—Ordinances have been passed for paving two streets with brick; estimates, $26,486.

FORT HOWARD, WIS.—Bids will soon be asked for paving several streets.

SPARTA, WIS.—Bids are about to be asked for paving one street with cedar blocks.

DULUTH, MINN.—The lowest bid for paving Kentucky Ave. was that of W. C. Doherty, $18,656.

CEDAR RAPIDS, IA.—Bids will be received until July 2 for paving and curbing several streets. F. Simmons.

OSKALOOSA, IA.—Bids are asked until July 1 for 10,444 sq. yds. brick paving, 2,480 lin. ft. cement curbing, 1,024 lin. ft. brick curbing, 2,656 cu. yds. excess grading. F. M. Shangle, Cy. Clk.

NEWTON, KAN.—Bids are asked until July 4 for 810 lin. ft. of 6-ft. stone sidewalk. B. H. Turner.

OMAHA, NEB.—The Board of Public Works will receive bids until July 1 for ten grading contracts.

SPRINGFIELD, MO.—Bids are asked until July 5 for paving two streets with brick. C. P. Johnson, Cy. Engr.

TORONTO, ONT.—Contracts have been awarded for paving between the tracks as follows: Construction & Paving Co., asphalt, $75,048; Robert Grant, cedar blocks, granite and cobble, $46,320.

ELECTRICAL.

HEMPSTEAD, N. Y.—The present contract for electric lights will expire in August, and it is reported that the committee will ask for bids from other companies before making a new contract.

ASHLEY, PA.—Nearly $10,000 is reported as already subscribed for an electric light plant. Frank L. Richards.

COLUMBIA, S. C.—A plant of 500 HP. will be erected by the Columbia Electric Street Railway, Light & Power Co.

TAMPA, FLA.—The Tampa Electric Light Co. has sold its plant to the Tampa Street Railway & Power Co., who will erect an entirely new plant. J. H. Ahern is president of the new company; capital, $1,000,000.

SPRING VALLEY, ILL.—The Committee on Lights will receive bids until July 5 for a municipal plant.

MILWAUKEE, WIS.—The Badger Illuminating Co. will purchase new dynamos and engines, at a cost of $15,000.

IOWA FALLS, IA.—At a special election June 15, a franchise for an electric light plant was granted to a local company.

PUEBLO, COLO.—It is reported that bids will soon be asked for a five years' contract for city lighting.

SEATTLE, WASH.—The Board of Public Works has been instructed to receive proposals for lighting the city for one year.

NEW PROJECTS.—The towns of Highland Falls, N. Y., and Georgetown, S. C., are considering the advisability of introducing electric lights.

NEW COMPANIES.—Electric Equipment Co., New York. N. Y.; $200,000; E. H. Johnson, E. H. Lewis. Electric Power Co., New Brighton, N. Y.; $150,000; Erastus Wiman, H. M. Morrell. Greenbush Electric Light Co., Greenbush, N. Y.; $25,000; Jas. Pidgeon and Jas. Murphy, both of Troy. Rome Electric Light Co., Rome, Fla.; $50,000; J. E. Lawrence, S. Bigelow.

CONTRACT PRICES.

SEWERS.—Battle Creek, Mich.—We are informed by W. W. Brigden, Ch. Engr., that the city has awarded the following contracts: Adams & Hall Bros., 500,000 brick, $6.50 per M.; F. W. Ward, 900 bbls. cement, $1.10 per bbl.; Vulcan Iron Works, Chicago, Ill., manhole curbs, $6.90, and dirt pails, $7.50 each; Atlas Clay Material Co., Chicago, Ill., sewer pipe at about 75% from list prices. The lowest bid for the construction was that of Wargos, Kery & McDonald, Port Huron: 36 × 54-in. and 35 × 50-in. brick, $2 per lin. ft.; 30 × 45-in., $1.90; 27 × 41-in., $1.85; 12 and 8-in. tile, 90 cts.; plank left in trench, $14 per M.; house connections, 50 cts.; earth excavation, 20 cts. per cu. yd. for haul of 500 ft. or less, and 15 cts. per cu. yd. extra for each additional 500 ft.; wooden wind gate, $35; putting in cast iron elbow for outlet, under water, $25.

Brooklyn, N. Y.—Contracts for four sections of the sewer in Ward 26 were awarded last week to John McNamee at about $850,000. The prices are as follows: 132-in brick sewer, $27 per lin. ft.; same, on pile, etc., $34; 126-in. $25.50; same, on pile, etc., $32.50; 120-in., $27.30; 102 and 96-in., $15; 90-in., $12.50; 84-in., $11; 78-in. $10; 72-in., $6.50; 66-in., $7; 60-in., $4.50 and $5; 54-in., $4.50; 48-in., $4; 42-in., $3.50; 30-in., $2.80; manholes complete, $27 and $30 each; basins, complete, $100; earth filling 25 and 35 cts. per cu. yd.; out-fall flume, $13.75 per lin. ft.; out-fall sewer, $61 per lin. ft.; twin sewers, complete, $60; trap basin, complete, $18,000; purification tanks, etc., $95,000. The contracts for the other two sections have been awarded to D. J. Creem at about $207,000. The prices for the section awarded last week are as follows: 54-in. brick, $3.90 per lin. ft.; 48-in., $3.50; 42-in., $3.40; 36-in., $3.35; 30-in., $2.75; manholes, complete, $32 each; basins, complete, $93 each.

Fond Du Lac, Wis.—Contracts have been awarded as follows: W. A. Roberts & Co., two contracts, 10-in. pipe, 41 cts. per lin. ft.; 6-in., 25 cts.; basins, $35 each; manholes $33; David Ahern, four contracts, 10-in., 42 to 47 cts.; 6-in., 25 to 27 cts.; 4-in., 23½ cts.; basins, $40 and $42.50; manholes, $31 and $32.

Reading, Pa.—The lowest bid for the storm water brick sewer was as follows: A. H. Tyson, 40 × 60 ins., $5.13 per lin. ft.; 36 × 54 ins., $4.59; 32 × 48 ins., $3.95; 24-in pipe, $2.20; 12-in., depth, 5 to 8 ft., 97 cts.; same, depth, 8 to 12 ft., $1.10; 9-in., 80 cts.; manholes, $4.75 each; basins, $112.50; inlets, $33; iron castings, 2¾ cts. per lb.; concrete, $4.25 per cu. yd.; timber foundations, $20 per M.

STREET WORK.—Montreal, Que.—The Road Committee has awarded the contracts for paving several streets with asphalt to Jas. Cochrane at $3.39 per sq. yd. for 2 ins. of Sicilian rock asphalt on 6 ins. of concrete.

Columbus, O.—The contract for paving Livingston Ave. with Hayden blocks has been awarded to N. B. Abbott, at $2.10¼ per sq. yd.

Sioux City, Ia.—Contracts for grading have been awarded at from 9 9-10 to 32 cts. per cu. yd.

WATER-WORKS SUPPLIES.—Syracuse, N. Y.—The Water Board has awarded the contract for pipe and castings during 1892 to the National Foundry & Pipe Works, Scottdale, Pa., at $21.70 per ton for pipe, and 2¼ cts. per lb. for special castings, delivered f. o. b. The contract embraces 300 tons of 21-in. cast iron pipe, 200 tons 16-in., 30 tons 12-in., 2 tons 10-in., 12 tons 8-in., 12 tons 6-in., 1 ton 4-in., and 52,000 lbs. special castings, with the privilege of additional orders not to exceed 1,000 tons.

GASOLINE.—Baltimore, Md.—The contract for supplying gasoline and filling city lamps for one year has been awarded to Chas. H. Nicolai, at $9.90 for each lamp in the city proper and $9.95 in the annex.

MISCELLANEOUS.

STEPS.—New York, N. Y.—An appropriation of $50,000 has been voted to build steps on the north side of Washington Heights' viaduct. There will be 118 steps.

SHEET IRON, ETC.—Washington, D. C.—Bids will be received at the Bureau of Provisions and Clothing, Navy Dept., for about 162,290 lbs. sheet iron, 20,000 lbs. angle iron; 2,000 lbs. rivets, etc., for the New York and Norfolk navy yards; also for 3 vertical boring and turning machines, zinc, broken stone, forgings, steel, etc., for the Washington Navy Yard. Edwin Stewart, Paymaster-General, U. S. N.

GAS.—Camden, N. J.—The American Gas Co. has been incoporated by G. G. Ramsdell, M. W. Stroud, Philadelphia, Pa., and M. W. Cox; capital, $500,000.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., have an order for 10 passenger engines for the Baltimore & Ohio; 3 will be built to the Baldwin design, and 7 to the design of Mr. Hazlehurst, Superintendent of Motive Power of the Baltimore & Ohio R. R. The Schenectady Locomotive Works, Schenectady, N. Y., have built 10 consolidation engines for the Duluth & Iron Range. The Cooke Locomotive & Machine Works, Paterson, N. J., have built 22 ten-wheel engines for the Houston & Texas Central, and have orders for 3 fast passenger engines and a mogul switch engine for the Delaware, Lackawanna & Western; the former have cylinders 19 × 24 ins., and driving wheels 5 ft. 4 ins. diameter. The Baltimore & Ohio is enlarging its Mount Clare shops at Baltimore.

CARS.—The Wells & French Co., Chicago, is building 500 box cars of 50,000 lbs. capacity for the Minneapolis, St. Paul & Sault Ste. Marie. The Tredegar Iron Works, Richmond, Va., have an order for 50 box cars of 60,000 lbs. capacity for the Norfolk & Southern. The Northern Pacific has built 25 Street stable cars at its shops at Edison, Wash.; 175 more are to be built. The Pullman Palace Car Co., Chicago, Ill., is building 55 vestibuled chair cars for the Chicago, Burlington & Quincy.

THE BARNEY & SMITH CAR CO., Dayton, O., has received subscriptions for $3,500,000 share capital. The company will carry on the works of the Barney & Smith Mfg. Co., established in 1849.

CAR REPLACERS.—Orders for car replacers manufactured by B. E. Tilden & Co., Monadnock Building, Chicago, have been received from Panama. The company has replacers in use in Cuba and Australia, and on 300 or 400 railways in the United States, Canada and Mexico.

STEEL COLUMNS.—The Larimer column, placed upon the market about a year ago, has been extensively adopted, 500 tons having already been sold. About 413 columns 8 to 16 ins., are to be used in the new Huck & Young building, Chicago. The 16-in. weigh 1,500 lbs. and the 8-in., 190 lbs. They are also being used in the new Boston & Northwestern Real Estate Building, St. Paul, Minn. It was patented by Mr. C. Larimer, and is manufactured by the Jones & Laughlin Co., Chicago, which is providing facilities for greatly increasing the output, the company now being behind on its orders. A cross section of this column was given in our issue of Dec. 12, 1891, and we shall probably give fuller particulars later.

THE FALLS HOLLOW STAYBOLT CO., Cuyahoga Falls, O., reports that its mandrel-rolled hollow staybolts have been recently introduced by the Michigan Central, Long Island, Delaware & Hudson and Manhattan Elevated Ry., in addition to other roads already using them. The good quality of these staybolts was shown in tests made by Prof. J. B. Johnson, and recently published in our columns.

THE BERLIN IRON BRIDGE CO., East Berlin, Conn., is building a machine shop for the Solvay Process Co., Syracuse, N. Y. The building will be 50 × 300 ft., and three stories high. The side walls will be of iron and brick (combination construction), with iron floors and iron roof covered with the Berlin Bridge Co.'s patent anti-condensation roofing.

THE BALTIMORE MALLEABLE IRON & STEEL CASTING CO., Baltimore, Md., has completed its new works, covering a lot 120 by 334 ft., and including a foundry 100 × 50 ft. and an annealing house 100 × 40 ft. Pres., Patrick Kennedy.

NEW COMPANIES.—Standard Paving Co., Chicago, Ill.; $50,000; P. E. Johnson, T. J. Griffin and A. F. Vallette. Calvert Brick Co., Baltimore, Md.; $500,000; Jos. Strauss, J. S. Rosenthal, G. Cook. Standard Brick Co., Passaic, N. J.; $50,000; C. H. Pell, Oliver Drake. Parshall Compressed Air Refrigerating Apparatus Co., Chicago, Ill.; $250,000; C. H. Parshall, J. S. McVicker and Jonah Crowell. Pittsburg Heating Supply Co., Pittsburg, Pa.; $20,000.

CURRENT PRICES.

RAILS.—New York: $30 at Eastern mills, $30.75 at tidewater; old rails, $17 for iron and $13 for steel. Pittsburg: $30; old rails, $19 for iron and $15 to $16 for steel. Chicago: $31 to $31.50; old rails, $18 for iron and $12.50 for steel.

TRACK MATERIALS.—New York: steel angle bars 1.55 to 1.6 cts.; spikes, 1.95 to 2 cts.; track bolts, 2.5 to 2.6 cts. with square and 2.7 to 2.8 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.8 cts for iron and 1.8 to 1.9 cts. for steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.7 cts. for iron and 1.75 cts. for steel; spikes 2.1 to 2.15 cts.; track bolts, 2.55 cts. with square and 2.6 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57¼ and 47½ per cent. on black and galvanized butt-welded; 67¼ and 55 per cent. on black and galvanized lap-welded. Casing 55 per cent.

FOUNDRY PIG IRON.—New York: $14 to $16. Pittsburg: $13.50 to $14.50. Chicago; $13.50 to $15.

LEAD.—New York: 4.1 to 4.15 cts. Chicago: 4 to 4.07 cts. St. Louis: 3.95 to 4 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.1 to 2.5 cts. for large lots, and 2.25 to 2.65 cts. for small lots; channels, 2.25 to 2.5 cts.; angles, 1.85 to 2 cts.; tees, 2.3 to 2.75 cts.; sheared iron plates, 1.8 to 2.25 cts.; steel plates, 1.8 to 1.9 cts. for tank, 2 to 2.25 cts. for shell, 2.3 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 1.9 to 1.95 cts. for large lots, and 2 to 2.05 cts. for small lots; channels, 1.9 to 1.95 for large lots, and 2 to 2.05 cts. for small lots; angles, 1.8 to 1.85 cts.; tees, 2.35 cts.; universal mill plates, 1.8 to 1.9 cts. for iron and steel; sheared steel bridge plates, 1.95 to 2 cts.; refined bars, 1.65 to 1.7 for iron and steel; steel plates, 1.75 to 1.85 cts. for tank, 2 to 2.1 cts. for shell, 2 to 2.15 cts. for flange, 3.5 to 3.75 cts. for firebox. Chicago: beams, 2.15 to 2.25 cts.; channels, 2.15 to 2.25 cts.; angles, 1.85 to 1.9 cts.; tees, 2.4 cts.; universal plates, 1.9 cts.; sheared steel plates, 1.95 cts.; steel plates, 2.3 to 2.4 cts. for tank, 2.0 to 2.75 cts. for shell, 2.9 to 3 cts. for flange.